DOCUMENT RESUME

ED 381 401 SE 056 271

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TITLE Everyday Thoughts about Nature: An Interpretive Study of 16 Ninth Graders' Conceptualizations of Nature.
PUB DATE Apr 95
CONTRACT NSF-RED-9055834
NOTE 79p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (San Francisco, CA, April 22-25, 1995).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Case Studies; Environment; Environmental Education; Grade 9; *Instructional Improvement; Natural Resources; Science Education; *Scientific Attitudes; Secondary Education; *Student Attitudes; Student Surveys
IDENTIFIERS Man Nature Relationship; *Nature

ABSTRACT

This study investigates student world views in an effort to provide information that will improve the learning environment of the science classroom. The research focuses on furthering knowledge of students as people in the context of investigating what students think about nature or the natural world. The objective of the descriptive case study is to come to a better understanding of the cognitive culture of 16 ninth graders from a semi-rural high school in the central desert region of Arizona. A modified naturalistic inquiry approach using a semi-structure interview technique was employed. A number of assertions are examined relating to variations in views of the natural world based on differing perspectives, gender, religion, integration of school science in everyday thinking, science grade success, and environmental awareness. Implications for further research and instructional improvement are discussed. Results show that student ideas are often both rich and rational. Yet within the richness of student comments little pertained to science, and only one student's conceptualization of nature reasonably matched the naturalistic-mechanistic view of nature common to science education. An appendix provides concept maps and narrative transcripts. Contains 49 references. (LZ)

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ED 381 401

Everyday Thoughts about Nature: An Interpretive Study of 16 Ninth Graders' Conceptualizations of Nature[1]

A paper presentation in Strand Two of the 1995 Annual Meeting of the National Association for Research in Science Teaching

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[1] This research was supported by a National Science Foundation research grant (RED 9055834)

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"The proper study of mankind is man."
Alexander Pope[2]

"You cannot study people. You can only get to know them."
C. S. Lewis[3]

Alexander Pope expressed the Enlightenment ideal of broadening the Scientific Revolution to include the study of human beings not only as physical organisms but psychological ones as well. The scientific study of the human being flourished and eventually spawned many new and more specific disciplines. Among these one counts the scientific study of science learning and teaching. All of this is part and parcel of modernism. Without commenting on the successes and failures of modernism, suffice it to say that in many disciplines today many scholars look to very different methods for addressing the questions they have about people and their behavior. There has come an attitude shift nicely summarized in C. S. Lewis' two brief sentences quoted above. It is an attitude most clearly seen to date in feminist scholarship of which Carol Gilligan's (1982) *In a different voice* and the Belenky, Clinchy, Goldberger, & Tarule. (1986) study *Women's ways of knowing: The development of self, voice, and mind* are seminal examples. If I may paraphrase and adapt from these scholars, there are voices of people that need to be heard if scholars intend to have a valid understanding of people and their behavior. The feminist scholars were of course seeking ways of making women's voices heard but the importance of their work exceeds gender issues. It is important for restoring the image of people as persons rather than as objects of research. The foundational perspective for research through the Scientific Literacy and Cultural Studies Project (SLCSP) is that one must hear from science students about themselves. The specific research question being reported here is, What is it that students think about nature or the natural world? The rationale for this question vis-à-vis science education is offered below.

The Theoretical Framework

People are purposive, intentional beings. People are habitual creatures and yet full of surprises. People can be quite unpredictable. For these reasons and many others it is difficult to come to know people in the sense of having a causal understanding of human behavior which was the modernist project. At least this cannot be done as scientists do with moving objects, for example, or even with the behavior of other animal species. A person, however, can tell you about him or herself thus helping you to get to know this person. This is of course a different kind of knowing and it suggests that getting to know a broad range of people provides an educator with exemplars of what people in general are like. "Interpretive researchers," noted Cobern (1993a, p. 936), "do not expect that the procedures of experimental natural science can ever be used to produce general laws of education. Rather, one must come to a greater understanding of what meaning is and how it is created. Similarly, the classroom environment is not to be composed of causal variables which the teacher manipulates to foster learning, but an environment mutually shaped to fit

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[2] From *An Essay on Man* [1733-1734]. Epistle II, l. 1.
[3] Quoted in Como (1994, p. 116).

the members of the classroom, both teacher and students." SLCSP research takes it thus as axiomatic that the more educators know about students as people the better educators will be able to teach people as students in their classrooms.

One knows from diverse fields as theology, cognitive anthropology, and philosophy that a person's thinking is based on a set of first principles, so to speak. This is a worldview according to Cobern (1991a) and it is "not merely a philosophical by-product of each culture, like a shadow, but the very skeleton of concrete cognitive assumptions on which the flesh of customary behavior is hung" (Wallace, 1970, p. 143). These assumptions, or more specifically presuppositions, exert a broad influence over one's thinking although the intensity at any one point is likely to be low (Jones, 1972). One also knows from wise philosophers such as John Dewey that all experience for a person is continuous. Yes, as children grow, and certainly as adults, many learn to box off portions of their thought lives so that, for example, scientific and aesthetic knowledge become separately and exclusively boxed. Science educators are well aware of the phenomenon of boxing science as school knowledge. This is a learned behavior that works against the long term best interests of the person and of the disciplines involved. Thus if one takes seriously the concept of worldview and Dewey's assertion that all experience is continuous, then one can state with considerable assurance that the beliefs and experiences students bring to the classroom influence their learning experiences in the classroom. Moreover, it is not at all clear that teachers and professors will immediately recognize connections that for any given student are quite important. Therefore, as one gains knowledge of what kids bring to the classroom one gains insight to how learning environments can be more effectively designed. At this point SLCSP research seeks to supply some of this descriptive data. Clearly, however, information could come from anywhere and, as Neil Postman (1984) is wont to say about modern culture, one could drown in a sea of irrelevance. To avoid this SLCSP is grounded in a logico-structural theory of worldview (Kearney, 1984, Cobern, 1991a) which provides direction as to what research questions to ask.

Worldview research in science education dates at least to Kilbourn (1984) and Proper, Wideen, and Ivany (1988). Cobern (1991a) borrowed a logico-structural model of worldview from anthropologist Kearney (1984) in an attempt to bring greater coherence and sophistication to worldview research in science education. Briefly stated, the logico-structural model is a set of seven universally found, fundamental categories: Self, NonSelf, Classification, Relationship, Causality, Time, and Space. The theoretical work was extended in Cobern (1993b, 1993c, 1994) and applied to empirical work in Cobern (1993a) and Lassiter (1993). The research reported here has to do with the NonSelf. "The NonSelf can be divided into domains of... human environment and physical environment, or society and nature... Most cultures, including Western culture, have preferred Redfield's tripartite division: Humanity... Nature, and God..." (Cobern, 1991a, p. 45). More specifically, the present study focused on that subdivison of the NonSelf known as nature, or the natural world. By way of definition, Sperry (1983, p. 114) suggested that nature is "a tremendously complex concept that includes all the immutable and emergent forces of cosmic causation that control everything from high-energy subnuclear particles to galaxies, not forgetting the causal properties that govern brain function and behavior at individual, interpersonal, and social levels." This definition has a rather reductionist flavor characteristic of modern, Western culture. The Western view of nature is characteristically mechanistic, an inorganic view of the world as a "great machine, which, once it has been set in motion, by virtue of its construction

performs the work for which it was called into existence" (Dijksterhuis, 1986, p. 495). This mechanicism which dates to Newton posits the whole as a simple sum of its parts. Causal relations are linearly conceived and context independent. Key elements in this view are the "regularity, permanence and predictability of the universe" (Kearney, 1971, p. 24). With all due respect to quantum mechanics, mechanicism is orthodoxy and remains a pervasive view in Western culture.

True to their Western heritage, Americans frequently view nature as an object for "mastery" (White, 1967; Young, 1974). In other cultures nature is more likely to be valued for its beauty, if not actually held in reverence. These differences in world view have consequences. Watanabe noted that despite the frequency of earthquakes in Japan, it was only after contact with Westerners that the Japanese began the scientific study of earthquakes. According to Watanabe, "this can be explained largely by [the Japanese] attitude of coexisting with nature" (1974, p.281). American feminist literature records a similar attitude. The feminine presuppositions under girding the Self-NonSelf relationship are characterized by "interrelatedness and interconnectedness, wholeness and one-ness, inseparability of observer and observed, transcendence of the either-or dichotomy, dynamic and organic processes" (Perreault, 1979, p.4). Feminist scholarship such as Keller's seminal biography of Barbara McClintock, *A Feeling for the Organism* (1983), however, has helped to strengthen the feminist contention that good science does not necessarily require the traditional, Western view of nature.[4] It is interesting to note that some observers believe that the Eastern Self-NonSelf relationship will result in unique contributions to science, especially in ecology and anthropology.[5]

The traditional Western dominance theme does not necessarily lead to reckless individualism nor to the wanton exploitation of nature (Young, 1974). There are however those who believe that it does so necessitate, and they are not always gentle in their expressions and acts of opposition. The Indian philosopher Radhakrishnan (1967, p.145).commented that, "the modern mechanistic societies lack the vision of self in man. They recognize only an external mechanistic universe reflected in the machines that man has devised. This is how disintegration becomes the key image of the modern world." In the United States a small but growing group of people have adopted a radicalized Eastern view of the relationship between Self and NonSelf. As a result organizations such as the Animal Liberation Front and Earth First! actively seek the end not only of all animal experimentation in science, but as well an end to meat, leather, and wool industries (Los Angeles Times 1989, p.A6). The radical activists demonstrate how serious world view differences can be. That the differences can lead to anti scientific views has not gone unnoticed among some scientists. Warnings have been sounded by Holton (1993), Gross and Levitt (1994), and Theocharis and Psimopoules (1987) among others.

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[4] Also see Gilligan (1982). For a further discussion of a feminist position vis-à-vis a scientific world view, see Chapter 5, p.70.

[5] See for example, Frisch (1963); Watanabe (1974); Harding (1989). For an interesting discussions of how science education might look incorporating alternatives to a mechanistic view of nature see Franklin (1980); Miller (1980); and Scheirer (1980).

The science classroom cannot be exempted from this discussion on nature. From a worldview perspective, one must ask, What is the image of nature projected in the science classroom? What is nature like according to science instruction? Smolicz and Nunan (1975), Kilbourn (1984), Proper, Wideen, and Ivany (1988), Wilson (1981), Whatley, (1989), and Woolnough (1989) all suggest that mechanicism is prevalent in Western science education. Is it wise for educators to assume that students coming into the science classroom will fully accept as both appropriate and important the image of nature projected there, when the literature indicates that there are many views of nature? Indeed, given the criticism of modern, Western scientific views of nature (e.g., Merchant, 1989), should one not investigate the views fostered in a science class? There is here a broad area for research. SLCSP research specifically focuses on the importance of student belief[6], beliefs about nature in this case, to the learning of science. If one grants the important tenet of cultural studies that all ideas including scientific ones are expressed within a cultural system, then one must ask questions such as how does the cultural system of the science teacher and curriculum compare with the system or systems brought by the students. Thus, the research reported in this manuscript addressed the questions, How do students understand nature? What concepts have scope and power in their thinking? Where does science fit into their thoughts about nature? How is science interpreted when it has become an integral part of student thinking about nature? These are the cultural questions based on Geertz' (1973) view that culture is about "webs of significance."

These questions, moreover, suggest an alternative view of scientific literacy and literacy assessment. The elimination of scientific illiteracy is the principle and historic objective of science education at the school level. Scientific illiteracy is typically defined as a kind of cognitive deficit, to use Layton's (n.d.) and Jenkins' (1992) description, assessed by quantitative measures involving both science concepts and processes. The NAEP (1979) and Miller (1987, 1988) assessment series in the USA are good examples of this approach. Layton, Jenkins, MacGill, and Davey (1993) identified three weaknesses with this approach. The first is simply that literacy assessments involve a limited number of scientific concepts and it may well be that people taking the assessments know <u>other</u> things about science which are not on the assessment. Second, laypeople in contrast to scientists and science educators may have different interests and so the concepts used in the assessments are a mismatch with lay interests. Third, laypeople in contrast to scientists and science educators may have a different purpose for understanding science. The literacy assessments are based on a scientist's view of the natural world. In the public, the purpose for understanding science may have more to do with "'scientific savvy'... the practical 'street wisdom' which a citizen needs to cope effectively in an advanced industrial democracy" (Layton et al., 1993, p. 13). With these objections in mind, the acid test of whether science has influenced the way a person thinks is not a set of questions explicitly about science such as asking for an explanation of a particular science concept or the construction of an experiment to test a scientific hypothesis. No, the acid test is whether science has become an authentic part of a person's everyday thinking. Thus, the research reported here asked:

> **To what extent do students enjoin scientific knowledge vis-à-vis other domains of knowledge in a discussion about nature?**

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[6] The relation of belief to knowledge is addressed in Cobern (1994).

1) **Given, that science is unarguably relevant to the topic of nature and ought easily to be brought to bear.**

2) **Yet, nature is a topic that most people do not explicitly associate with science.**

Moreover, what are the concepts that appear to have scope and force in the students' thinking about this topic?

It is one thing to be able to give (or not give) correct answers on a science exam. It is quite another thing to use appropriately scientific knowledge in the absence of any kind of science prompt or cue.

The Students

The research was a descriptive case study of 16 ninth graders from a semi rural high school in the central desert region of Arizona. The 16 students are individual cases. They were not randomly chosen. They were selected by the two teacher/researchers who participated in the research. The initial strategy was to work with a range of typical students. The teacher/researchers asked for volunteers from their own classrooms and choose from these students whose grades ranged from "A" to "F." The students were from middle to upper middle income homes. The high school is located in an area many families choose because it combines proximity to a large city with a rural desert atmosphere. It is also somewhat of an artistic community that values the natural beauty of the Arizona desert. This should be kept in mind as the research assertions are discussed.

The study was done with ninth graders for several reasons. Ninth graders are the entering students at Arizona high schools. They are thus at the end of their elementary, general science education and at the start of more specialized secondary science education. They are, moreover, beginning a course of study that will form the foundation for tertiary education and employment after high school graduation. Finally, by working with ninth graders the researchers set the stage for a longitudinal study that will examine the respective influences of maturation and secondary science instruction. It was thus asked, Who are these kids entering our high school science courses?

The Method

The basic method of this research is a modified naturalistic inquiry (Lincoln & Guba, 1990) approach using a semi-structured interview technique (Kvale, 1983; Spradley, 1979). The interview procedures are described in Cobern (1991b, 1993a) and involve three devices to elicit conversation on the topic of the natural world. In brief, each student while thinking aloud, sorts a set of words and sentences according to how accurately they corresponded to the student's personal views. The interviewer, consistent with Spradley (1979) and Kvale (1983), asks probing questions and encourages the student to speak freely and at length. The findings are descriptive categories or codes applied to each interview transcript. These are subsequently are used to form concept maps which show the qualitatively different conceptualizations of nature held by the students (see Figure 1), and to develop first person narratives on nature for each student interviewed (see Figure 2). Such conceptualizations are called outcome space by Marton (1988) and belief space by Jones (1972). Through out the process from interviewing to coding to map and narrative production, the research team was alert for possible assertions about the students

that stood out in the data or in various ways occurred in the research team's deliberations and thinking about the data. These tentative assertions were logged for later use.

With maps and narratives in hand, the research team began the process of sorting, comparing, and cross checking cases by major code categories. For the first analysis the cases were divided by sex and examined for internal code consistency and cross group code differences. After this comparison similar comparisons of the cases were conducted by using each of the following codes as the initial point of division: religion, aesthetics, knowledge and science, order, and conservation. This process of comparing cases led to further tentative assertions which were added to the assertions gathered earlier in the research. This process ended with 37 assertions when the research team judged that the possible case comparisons had been exhausted. At this point the research team by consensus reduced the 37 assertions to seven logical groups. Each group then became the basis for a new assertion, most with multiple parts. The penultimate step was to cross check each assertion against each case for confirming and disconfirming data. In the final step of the analysis, two qualitative researchers not involved with this study cross checked the assertions, supporting arguments, and examples against the case concept maps and narratives. The final form is presented below.

The procedure described above represents a change from the bi polar code analysis that was used in the first conceptualizations of nature study (Cobern, 1993a). The assertion analysis approach is more typical of qualitative research (Denzin and Lincoln, 1994) and has the advantage of greater familiarity in the research community. Moreover, the research team found the statement form of assertions to be more informative than bi polar codes when considering the research and instruction implications of this research. We kept the notion of bi polar codes, however, in that each assertion is accompanied by counter examples.

Discussion of Assertions

Assertion #1: *Ninth grade students tend to discuss the natural world using several different perspectives (e.g., religious, aesthetic, scientific, conservationist)*

a) Any one student's discussion is typically characterized by a breadth of perspectives which may or may not be coherent.

b) Visible homogeneity among students (e.g., a classroom of middle class, Anglo students) can mask substantial variation of thought with regard to science and science related concepts.

Patricia is good example of the main thrust of this assertion. Glancing at her conceptual map (see Figure SAU.n2) one quickly sees religious, aesthetic, conservationist, and science elements.

> Patricia: God created the natural world. It has many characteristics. It's powerful, diverse, changeable, and physically and emotionally beautiful. Nature is anything made by God: all the plants and animals on earth and the entire solar system. The natural world is

very mysterious to me. I wonder about many things in nature. Something I wonder about is, What is way out in the universe? Perhaps another earth? Even though nature is mysterious, everything is knowable but maybe not in the near future. The wonderment of the world increases knowledge through science but is limited due to it's complexity. (SAU.n2 Narrative)

Bruce provides another example of this diversity of thought. Resources, conservation, complexity and order, scientific knowledge, and religion all have a part in his conceptualization of nature (see Figure SAU.n4)

> Bruce: The natural world is a world that is pure, unpolluted; a place where everything can live together. Nature is complex, but it is orderly and knowable... Most of the natural world can be known through science and the theories that have been developed by science.... Our knowledge is limited by hard questions such as, Why does the earth spin the way it does? What is gravity? Why is our planet solid and not gassy? This mystery and the knowledge we have, leads us to a philosophical sort of beauty. Having an open mind allows you to see the beautiful things in nature, like life in the Sahara Desert. Some people think it is ugly and a wasteland, but if you think about it, it has an abundant amount of life, which makes it beautiful. It is beautiful in different ways.... The natural world is exploited because of us, humans. The earth is in danger because humans are destroying the ozone layer, rain forests and precious land. An incredible things is that our resources are being exploited and used up, and we need these things to continue our life on this planet.... As humans, we have personal and religious obligations to our world to take care of it. (SAU.n4 Narrative)

Student views though showing diversity can be quite coherent as one sees with Patricia and Bruce. Alice provides another example of diverse but coherent thought about nature (see Figure ATG.n1). One again sees the aesthetic, conservationist, and scientific elements. One also sees that the conservation of a vulnerable earth requires care given by scientists; and that the lack of care leading to exploitation and endangerment can inhibit the work of science. Nature is both aesthetically and cognitively beautiful; and though there is beauty in nature, there is danger as well.

In contrast, Holly provides a very different example of how nature can be conceptualized (see Figure SAU.n7). There are some elements of diversity. One sees in her map the sub concepts of inclusion, resource, mystery and knowledge. Holly, however, seemed to have a very difficult time expressing much of anything about nature beyond a few disconnected thoughts. She seemed neither to have much interest in nor concerns about nature.

> Holly: The natural world is just there, you know, fish, bugs, dirt, animals, and plants.... It is very big and complex, like the ocean, which makes it somewhat confusing to know about.... People need to realize that our resources need to be protected... They can be recycled but I do not recycle because resources are probably not in danger now or during my lifetime, so what's the point? (SAU.n7 Narrative)

Holly's lack of interest in nature brings sub section B of assertion one to the fore. As previously noted, the students in this study attended a suburban high school of mostly middle and upper class, Anglo students. This visible homogeneity among students in fact masks substantial variation of thought with regard to science and nature. Holly's trivializaton of nature stands in marked contrast to the thoughtful sophistication of Patricia, Bruce, and Alice. It is fair of course to ask about these students' grade success. While it is true that Patricia's GPA is much higher than Holly's, both Bruce and Holly are B minus students. (Grade as a factor is specifically discussed under Assertion 5.)

Student variation shows itself in other ways as well. Of the sixteen students interviewed in this study, Howard showed the greatest proclivity to speak about science and to speak of it in favorable terms (see Figure ATG.n3). He showed a strong scientific, utilitarian view of nature.

> Howard: I think that nature can be fully known because it is logical.... Most things about nature are somewhat orderly or have a pattern to them. Because of this the study of science allows us to explain what is going on in nature. The orderliness lets us predict many things that are going to happen, like the weather, for example. Sometimes nature seems chaotic but that is mostly because our knowledge is incomplete and therefore our understanding is limited.... I think that everything can be explained by science. Matter, both living and non-living, and what it does follow basic laws.... things like the Law of Conservation of Mass, reproductive cycles of plants and animals, convection currents and ecosystems can be understood if the laws of science are studied. (ATG.n3 Narrative)

Art is Howard's opposing bookend, a mystical environmentalist. Like Howard, Art is both thoughtful and articulate, but his views on nature and science could not be more different (see Figure ATG.n4). The salient words on Howard's map are: Known, Complex, Resource, Logical, and Science. For Art they are: Vulnerable, Sacred, Knowledge, Conservation, and Resource. Even the two words they have in common mean very different things. Howard sees nature is a resource for physical needs. Art sees this also, but more importantly nature is a mental and spiritual resource. Both view nature as understandable. Howard is convinced that science will eventually explain all of nature; but Art is much more impressed with the knowledge of nature one achieves by personal experiences with nature and the type of knowledge traditionally held by Native Americans. One could almost say that Art is as much opposed to science as Howard is supportive.

> Art: Nature is a source of knowledge. That's a resource.... At the present time our knowledge of the natural world is limited. Many things that we perceive to be complex and confusing because we don't understand them are actually quite simple and orderly. The construction of a spider web, for example, is quite a complicated operation to us but to the spider building the web it is a simple procedure. As we gain in understanding of the diversity and power of nature, we will understand the perfect balance of everything in nature.... It is more important to have a spiritual understanding of nature than just scientific knowledge. That understanding can't be gained from school. You have to spend time in nature and learn to feel it. Than you will understand it.... The American Indian culture has the kind of understanding for nature that encourages preservation rather than

destruction.... Unfortunately scientists and scientific knowledge are also increasing our tendency to pollute, destroy and clutter up the earth and space. They are trying to destroy it and study it at the same time. (ATG.n4 Narrative)

To summarize this assertion, the individual students were not found to have conceptualizations of nature focused on one aspect of nature, for example a scientific understanding of nature. Rather, their views were typically a composite of a number of different perspectives. In terms of social and economic factors this was a homogeneous group of students. They nonetheless showed considerable conceptual variation, for example, sophisticated to unsophisticated, scientifically inclined to scientifically alienated.

Assertion #2: *Gender is not correlated with some common concepts ninth graders typically choose to use in a discussion about the natural world.*

a) *Ninth grade boys and girls appear to have few differences in the way they conceptualize nature. References to knowing about nature and science as a way of knowing about nature appear about as often regardless of sex.*

b) *Ninth grade girls are no more likely to hold nurturing, caring, or environmental views of nature than are ninth grade boys even though the literature suggests that these are feminine perspectives.*

c) *Most ninth grade students, whether boys or girls, have some form of aesthetic response to nature which can take one of three (sometimes overlapping) forms: intellectual perspectives, non religious emotional responses, religious or spiritual emotional responses*

Corollary: *Students with personal family experiences with nature (e.g., hiking, camping) are more likely to express positive emotional responses to nature than students without such personal experiences.*

For these ten ninth grade girls and six ninth grade boys, one could not say that science is more a boys interest. It is true that the student who spoke the most about science was Howard, but that is not say that he was representative of the boys. Howard was equally unrepresentative of both the boys and the girls. Kevin provides a more typical example of science talk.

Kevin: There are also knowable parts of nature. We can learn about nature through science. There is order to some things and we can base predictions on that. Examples of knowable, predictable things would be states of matter, life cycles, the earth's plates and sometimes the weather.... I want to be a scientist. Science raises many questions about nature. (ATG.n7 Narrative)

A glance at Kevin's conceptual map shows that in addition to science he is also very much interested in the environment, conservation, and a philosophical view of nature that supports a

sense of self (see Figure ATG.n7). Alice was mentioned above for her diverse view of nature. Like Kevin that diversity includes an appreciation for science.

> Alice: I want to be a scientist. Nature is very important to the world of science. Through science we understand many of the patterns in nature, food webs, weather patterns, how the solar system works, etc. We need to know more about nature and we keep studying it to find out how things work and to discover ways that different things affect each other. (ATG.n1 Narrative)

Bruce says, "Most of the natural world can be known through science and the theories that have been developed by science. Science enables us to predict, to some extend, everything such as weather, volcanoes, earthquakes and earth movement" (SAU.n4 Narrative). Sally concurs, "Science and scientists help us to know some of the natural world because things can be predicted, like animal behavior. The predictableness allows us to answer how things work..." (SAU.n5 Narrative).

Just as boys are often considered more scientifically inclined, girls are often considered more nurturing and environmentally inclined. As with the scientific stereotype, this one also does not hold for this group of students.

> Allen: If all people would care about the natural world, we could restore it so it would not be doomed. People need to realize that they are killing animals, plants and eventually themselves by polluting our earth and not doing anything about it.... People know what they are doing when they burn the rain forests, pollute the oceans, and drive cars; why don't they care? (SAU.n6 Narrative)

> Patricia: Our knowledge of the natural world throughout science allows us to use our natural resources and at the same time exploit them. This exploitation will eventually put an end to Earth life as we know it, if we don't start changing our way of living. (SAU.n2 Narrative)

> Simon: Our lack of understanding of nature has caused us to exploit our natural resources. Ultimately we are causing permanent damage because of such things as overpopulation, oil spills, cutting down trees, pollution, etc. Possibly we are doomed. We might be able to do some restoration that might help solve some of our problems.

> Samantha: Our earth is in trouble. It is being taken advantage of by people that are using parts of nature that don't really belong to them. This has caused a lot of pollution and wasting of endangered species. Most of the problems that nature has are caused by people not caring. (ATG.n5 Narrative)

Given the diversity of thought about nature and the caring attitudes among both boys and girls, it comes as no surprise that almost all of the students regardless of sex held significant aesthetic and emotional views of nature. Moreover, there was a diversity within aesthetic/emotional views. A

few of the students held intellectually oriented aesthetic views. Their view of beauty was grounded in knowledge.

> Bruce: This mystery and the knowledge we have, leads us to a sort of philosophical sort of beauty. Having an open mind allows you to see the beautiful things in nature, like life in the Sahara Desert. Some people think it is ugly and a wasteland, but if you think about it, it has an abundant amount of life, which makes it beautiful. It is beautiful in different ways. (SAU.n4 Narrative)

> Howard: I do enjoy being out in nature and thinking about different aspects of it. There is a beauty in all the ideas that there are in nature to learn about. (ATG.n3 Narrative)

A number of the students expressed aesthetic and emotional views of nature that were grounded in religious beliefs. These religious views occurred among both boys and girls.

> Patricia: God created the natural world. It has many characteristics. It's powerful, diverse, changeable, and physically and emotionally beautiful. (SAU.n2 Narrative)

> Liz: [Nature] is the work of God. It's purpose is to help us live and enjoy the beautiful things it provides us.... The natural influences the way we think. Just thinking about the natural world gives us peace and energy by knowing that the animals are okay and to see that we are not the only organisms living here. I live out in the desert where I can enjoy looking and thinking about the animals that live there. I get peace from that. (SAU.n8 Narrative)

> Art: There is a spiritual aspect to nature for many people. I find it quite beautiful, especially when I am looking out at a part of the natural world that is untouched by man. I appreciate the diversity of plants and animals in nature. Animals are very important to me. I can feel things through animals, I enjoy watching them and learning about them. I understand why nature is sacred to some groups of people. It is sacred to me. (ATG.n4 Narrative)

Ann provides a particularly interesting example in that she discussed her aesthetic and emotional sense of nature in both religious and intellectual terms. These concepts appeared to be mutually supportive of her aesthetic views. Ann and Sally are good examples of students with religiously grounded aesthetic views of nature.

> Ann: Nature provides both aesthetic and emotional pleasure and I need it for self renewal. I like to go where you can't see any influence by man. When I'm out in nature I feel calm and peaceful. It is a spiritual feeling and it helps me understand myself. I also get a spiritual feeling from nature. Sometimes, when I'm out in nature and I have time to think, I start to wonder about things. This leads me to ask questions that I'd like to find answers to. The pleasure I get from nature is enhanced by the mysteries I see in it. (ATG.n6 Narrative)

Sally: Knowing that the natural world was given to us by God gives me a wonderful and uplifting feeling. God intended the humans to be the superior-powerful people they are, not so they could exploit nature but so they could become stewards of our Earth. [Nature] is a beautiful place, not only physically but emotionally.. (SAU.n5 Narrative)

Religious factors are further discussed under Assertion 3. Although student thinking shows overlap concerning the grounding of aesthetic views, most of the aesthetic and emotional views were not linked to either intellectual thought or religion.

Paula: Nature is mysterious. I wonder about nature. I would enjoy living in the mountains where the ground has been untouched by humans so I could appreciate the beauty and purity of the natural world. (SAU.n1 Narrative)

Simon: I really enjoy being out in nature. It gives me good feelings. I like walking around, climbing mountains, watching a deer drink out of a river and things like that. I think about nature and you could say I'm in touch with nature. Though I understand only a little about it, I like the mystery of not understanding everything. It adds to the beauty. Nature can be peaceful, with calm breezes, lots of nice trees and no trash. (ATG.n2 Narrative)

Kevin: I live in a natural area. Being in nature is important to me. I can see and feel it so I know it exists. I enjoy the beauties of nature, the animals, mountains etc. It supports my sense of self. (ATG.n7 Narrative)

The students who spoke most strongly about the beauty or emotional appeal of nature often spoke of personal experiences of a recreational type with nature. Simon, for example, speaks of hiking and climbing. Ann refers to time out in nature. Moreover, several of these students live in rural areas. Liz tells us that she lives in the desert. Kevin says he lives in a natural area. The research did not pursue these types of experiences but it seems likely that home location and recreational activities are likely to be formative elements in a person's thinking.

Assertion #3: ***Religion is a significant factor in many students thinking about nature. The influence of religious thought shows wide variations of strength. Moreover, a strong religious influence can work either for or against a scientific understanding of nature.***

Almost all of the students in the study had at least a comment about God, religion, or spirituality with regard to nature. For some, religion constitutes a central reality for their lives and it shows in conversation about nature.

Samantha: My feelings about nature include religious feelings too. Sometimes when I think about nature, I also think about God. These are my first thoughts when you say the word nature.... Because nature comes from God, we have an obligation to take care of it.... [Nature is] mysterious, I like to think about it.... I spend a lot of time in nature. I'd be pretty bored if I didn't have it. It's sacred. (ATG.n5 Narrative)

Moreover, Samantha's map shows that her spiritual beliefs are not only salient but support her view of science (see Figure ATG.n5). Ann shares a similar view of nature, religion, and science.

> Ann: To me, nature is beautiful and pure because it is God's creation.... I also get a spiritual feeling from nature. Sometimes, when I'm out in nature and I have time to think, I start to wonder about things. This leads me to ask questions that I'd like to find answers to. The pleasure I get from nature is enhanced by the mysteries I see in it.... Nature is knowable but the questions I ask about nature make me think that nature is sometimes very confusing. It is also changeable. There are some things like the weather that we can predict but other things are not predictable. some things, like earthquakes, can be dangerous because of their unpredictability. We can learn to understand many things about nature through personal experience, school and science. Science, itself, provides us with technology which, in turn increases our scientific knowledge. (ATG.n6 Narrative)

The religious beliefs of other students, such as Alice (see Figure ATG.n1), seem to have much less impact on the way they conceptualize nature. On Alice's map religious concepts are present but not nearly as prominent as are concepts related to a scientific understanding of nature.

> Alice: I want to be a scientist. Nature is very important to the world of science. Through science we understand many of the patterns in nature; food webs, weather patterns, how the solar system works, etc. We need to know more about nature and we keep studying it to find out how things work and to discover ways that different things affect each other.... I'm not sure about the connection between God and nature. While I am a Christian I also believe that science has proved wrong many of the things in the Bible. Yet, I do think that there is a purpose for our existence and God is behind it. Science can explain how things work but there are many why questions that science doesn't answer. (ATG.n1 Narrative)

For Samantha and Ann religion supports their scientific views of nature. For Alice, religion and science serve complimentary purposes. They address the questions why and how, respectively; but for Alice science and religion can also be in conflict. In those conflicts she appears to side with science.

For other students, conflicts between scientific and religious views can pose much more confusing and difficult dilemmas. Paula is an interesting student in this respect. To begin with she neatly divides her world into nature with people and nature without people; and she clearly viewed nature without the corrupting influence of people as ideal (see Figure SAU.n1). Paula had a primitivist, anti technicist outlook on life and spoke approvingly of pre modern life. Her views include a strong spiritual element.

> Paula: The natural world was in existence before the dawning of man. God created the natural which makes it very mysterious and, for the most part, is unexplainable. God intended it to be here for a purpose which is only known by him. Because it is God's, humans have no right to mess with it. Even with the best technology and scientists we will probably not every fully understand nature. When man entered this planet, he destroyed its purity, beauty, and power. With the exception of hippies, who value the spiritual

ideals, the emotional values, and the mystery of nature, man has doomed the planet. I don't understand the human world and why people feel the need to study nature. Studying nature only causes trouble. It creates more technology and curiosity which leads to the exploitation of the land. (SAU.n1 Narrative)

Under Assertion 1, Art was cited as a non scientific type of student. A closer examination of his concept map (see Figure ATG.n4) show him to be somewhat of a spiritual mystic with anti scientific sentiments.

Art: As we gain in understanding of the diversity and power of nature, we will understand the perfect balance of everything in nature. We will also begin to understand our place within nature. It is more important to have a spiritual understanding of nature than just scientific knowledge. That understanding can't be gained from school. You have to spend time in nature and learn to feel it. Than you will understand it. There is a spiritual aspect to nature to many people. I find it quite beautiful, especially when I am looking out at a part of the natural world that is untouched by man. I appreciate the diversity of plants and animals in nature. Animals are very important to me. I can feel things through animals. I enjoy watching them and learning about them. I understand why nature is sacred to some groups of people. It is sacred to me. The American Indian culture has the kind of understanding for nature that encourages preservation rather than destruction.... They do not think of themselves as superior beings and don't feel that they have a right to go around destroying nature. They leave it the way it is because nature was made a certain way and it is supposed to be kept that way. Unfortunately, scientists and scientific knowledge are also increasing our tendency to pollute, destroy and clutter up the earth and space. They are trying to destroy it and study it at the same time. I believe nature needs to be protected.... Nature is something felt! (ATG.n4 Narrative)

Under Assertion 1, we spoke of the diversity of views held by this group of ninth graders. One can now see that this diversity includes religious thought. Most students seem to have some since of religion or the spiritual. For some, religious perspectives are quite powerful, but not so for others. Even those with the strongest religious or spiritual perspectives, there are considerable differences, at least with respect to scientific knowledge.

Assertion #4: *After 9 years of schooling, the level of science integration within everyday thinking remains low among ninth graders. Their discussions of nature involve little use of school science knowledge. Students often "name drop" school science topics such as the ozone layer, rain forests, or the Big Bang theory. In other words, they mention such topics without elaboration even when asked.*

a) *In spite of elementary science education experiences, many students do not see much order in nature.*

b) *By the middle adolescent years of ninth grade, some students show signs of an anti-science perspective while others seem barely to know science exists.*

What should students leaving the k-8 grades know about science? This is not an easy question to answer and one will not be attempted here. Without an answer, however, one also cannot be too judgmental of students. Thus it is not the intention of this assertion to judge ninth grade students nor their science education experience as elementary students. The intent is to provoke discussion about expectations for elementary school science by showing the science statements made by this group of students. It should already be clear from Assertion 1 and an examination of students' various conceptual maps that, with the exception of Howard, student conversation about nature does not dwell on science. Rather, students use a number of different ideas when they speak about nature. When students do mention science or speak of ideas that are within the realm of science what they do not do is elaborate. Jackie (SAU.n3) offered that, "Nature... is everything around us like plants and animals," and "These resources are essential for life and... using them leads to pollution that is destroying our ozone layer." Even though prompted during the interview, she offered no explanation nor even any examples. This approach is more like name dropping than thoughtful discussion. Betty provides similar example but with what appears at first to be greater substance.

> Betty: Nature is knowable... people know nature on a scientific or factual basis. Their knowledge is based on facts and can be applied to solving problems as it is logical. There is an order to nature which we can use to predict some things, weather for example. Ideas about evolution, the ice age, extinction's and global warming can be developed and studied with scientific methods and proofs. Medical cures are another benefit we've gained through factual knowledge. (ATG.n8 Narrative)

Here one sees a student who has a more developed sense of what science is and how it works. Science is logical and factual, and can be applied to solve problems. There is order in nature that allows a certain amount of prediction. On the other hand, none of the statements is elaborated and the examples remain rather simple and unelaborated.

Another interesting aspect of the student discussion is the attention paid to the notion of order in nature. One sees the concept in Betty's statement above. Howard, the scientifically out spoken students commented that, "Most things about nature are somewhat orderly or have a pattern to them. Because of this the study of science allows us to explain what is going on in nature. The orderliness lets us predict many things that are going to happen, like the weather, for example" (ATG.n3 Narrative). This, of course, is what science educators would like to see. The AAAS noted that, "Science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful, systematic study" (1990, p. 2, emphasis added). What is of interest about these students, however, is not that Betty's or Howard's statement about order is typical but that these statements are atypical. Indeed, some students are much more impressed by the disorder they see in nature than by the order that science takes note of.

> Simon: Although I've thought a little bit about the natural world, I don't really understand a lot of things. I suspect that much of nature isn't meant to be understood. Because nature lacks order and is often unpredictable, it is often unexplainable. some things like weather and ocean patterns can be predicted but many dangerous things might not be

predicted - earthquakes and natural disasters for example. Animals also do things that we don't understand and can't explain. (ATG.n2 Narrative)

A quick glance at Simon's conceptual map (see Figure ATG.n2) reveals that, not only does he not speak of order, he does not speak of science.

Simon was one of three students in this study who seemed totally unaware that science had anything at all to do with nature. Holly is another.

> Holly: The natural world is just there, you know, fish, bugs, dirt, animals, and plants. There are aspects of nature that have purpose because it was probably created by God, but I am not really religious so I can't explain it. It is very big and complex, like the ocean, which makes it somewhat confusing to know about. There is some order in nature, but not much. (SAU.n7 Narrative)

Holly thinks there is some order in nature but the words "complex" and "confusing" suggest she is more impressed otherwise. Again, there is no mention of science (see Figure SAU.n7). The third student is Allen. He says nothing that about order and never mentions science. The closest he came to a scientific statement was, "Nature is knowable to some extent; like people can recycle and fix the ozone layer by not driving cars and stuff" (SAU.n6 Narrative).

As detached from science as these three students appear to be, they expressed no anti science sentiments. Other students at this relatively early age to express anti science feelings. One of these is Art who we have already heard from above under Assertion 1. Paula expressed similar thoughts.

> Paula: I don't understand the human world and why people feel the need to study nature. Studying nature only causes trouble. It creates more technology and curiosity which leads to the exploitation of the land. (SAU.n1 Narrative)

Her concept map (see Figure SAU.n1) show a strong sense of the mystery of nature and spiritual values concerning nature. Nature is for the most part unpredictable. Nature is interesting but not in terms of any technical knowledge about nature. She never spoke of science but it seems clear that her notion of technical would include science.

Assertion #5: *Science grade success is not correlated with the concepts ninth graders typically choose to use in a discussion about the natural world.*

a) *The students with the most grade success in science have not necessarily grasped fundamental concepts about nature and science such as the concepts of order and pattern.*

b) *Grade success in the science classroom does not mean that a student will understand that science is about nature. The students with the most grade success in science do not necessarily demonstrate a scientifically informed view of nature.*

In the above discussion it was noted that students like Betty and Howard perceive order in nature and that scientific knowledge to at least some extent is predicated upon order. Betty is a "B" minus student. Howard, the science type student that one might have thought to be an "A" student, happens also to be a "B" minus student. Allen and Holly who see little order in nature and have nothing to say about science are "C" students. In terms of grade success there is not much difference between the four. Even more surprising are the "A" students, Patricia, Sally, Liz, Ann, and Kevin. These students achieve high grades across subject areas including science. During the interviews each spoke at least a little about science and yet none choose to speak of nature as having order or spoke in terms of what the AAAS would consider a scientific worldview.

> Kevin: I think nature is very complex. There are unknown parts of nature and they are confusing to me because there are no real laws controlling them. There is no order. These parts of nature can be very powerful, dangerous and unpredictable. (ATG.n7 Narrative, emphasis added)

While Kevin speaks of no order in nature, Ann thinks something's are predictable yet also says nature can be confusing.

> Ann: Nature is knowable but the questions I ask about nature make me think that nature is sometimes very confusing. It is also changeable. There are some things like the weather that we can predict but other things are not predictable. some things, like earthquakes, can be dangerous because of their unpredictability. We can learn to understand many things about nature through personal experience, school and science. (ATG.n6 Narrative)

Of course, even for the best of scientists nature can be confusing. What is missing in Ann's and Kevin's' remarks is any hint that there is an underlying order in nature that makes science possible. Yet, these are both "A" students. Another of the "A" students, SAU.n8, spoke of science as a body of factual knowledge but with little hint of scientific process or the tentative nature of scientific knowledge. Again, one does not see scientific knowledge grounded in the orderliness of nature.

> SAU.n8: The natural world is knowable by means of education through science and by learning through personal experiences. Eventually we will probably be able to know most things about the natural world. However some things will be kept a mystery because not all things are meant to be known. Science tends to teach the how and what questions about the natural world and religion hints at the why questions, somewhat. Before it can be knowable to someone, that person must care about the natural world. Lack of care not only hinders your personal thought, it sometimes leads to exploitation of natural resources and natural environments like the rainforests. (SAU.n8 Narrative)

Of this group, only Sally spoke of order in nature, at least in terms of predictableness.

Sally: The natural world is somewhat knowable through science and religion. It is too big to be entirely explained. For example, how can you be sure that an animal is truly extinct if you can't explore all areas of the world? Science and scientists help us to know some of the natural world because things can be predicted, like animal behavior. The predictableness allows us to answer how things work, but we will never really know why things work. Why is nature here? What is the purpose? How did life form? Some things are unpredictable like hurricanes, tornadoes, and volcanoes, which make nature dangerous at times. Science can teach us how to be better conservationists through research and technology so we can avoid pollution which ruins nature. (SAU.n5 Narrative, emphasis added)

In summary, one might think that students with grade success in science would have grasped an important assumption in science, that is, that science is predicated upon an assumed orderliness in nature. That does not appear to be the case with this group of ninth graders. Moreover, even among the best students one gets little science of a scientific way of thinking. As noted under Assertion 4, it is not clear what should be expected of recently graduated elementary school students. Thus, one must not be too judgmental. It is, nonetheless, of considerable interest that good students after nine years of school have so little to say about either a major assumption of science or the processes of science.

Assertion #6: *Ninth grade students articulate a high degree of environmental awareness, even students with little grade success in science. Indeed, student environmental awareness is often not connected with science.*

a) *Nor is student gender typically correlated with environmental awareness.*

b) *Instead, students typically cite either religious obligation or the need to protect resources as the reason for conserving nature.*

It has been heartening in this study to see the level of environmental and conservationist interest displayed by these ninth graders. Though several of the students have not achieved much grade success in science, these too show environmental awareness.

Art: Nature is vulnerable to our influence and as our population has grown nature has been affected. Man has changed the natural world by exploiting its resources and polluting the environment. We have depleted the rainforests and changed the balance of natural things. I am concerned about the pollution we have caused, the things we have lost from the rainforest without knowing they are there, the damage we have done to Earth's water. Now we don't have the opportunity to gain knowledge from what we already have destroyed.... I believe nature needs to be protected. Everything has a purpose that is put on this planet. We have a purpose here also. Maybe it is to preserve nature, have fun and enjoy the spiritual quality instead of destroying it. It is our responsibility to know and understand human impact on the fragile, easily tampered with balance of the natural world. (ATG.n4 Narrative)

Allen: If all people would care about the natural world, we could restore it so it would not be doomed. People need to realize that they are killing animals, plants and eventually themselves by polluting our earth and not doing anything about it.... Nature gives us all we need to survive, like food, water and air along with the abundant resources such as coal, oil, gas and wood; so if we don't conserve these, the natural world would not exist as we know it. People know what they are doing when they burn the rain forests, pollute the oceans, and drive cars; why don't they care? There are things we can do to fix the earth so it can be restored to it's original state which would be very peaceful. (SAU.n6 Narrative)

Neither Art nor Allen is a very successful student, thus one has the impression that here at least is a subject from the science classroom, environmentalism, that has had an impact on the students. At times, however, student environmental views can be extreme.

Paula: I believe that there are two aspects of nature; the natural world and the human world. The natural world was in existence before the dawning of man.... Even with the best technology and scientists, we will probably not every fully understand nature. When man entered this planet, he destroyed its purity, beauty, and power. With the exception of "hippies", who value the spiritual ideals, the emotional values, and the mystery of nature, man has "doomed" the planet.... I don't understand the human world and why people feel the need to study nature. Studying nature only causes trouble. It creates more technology and curiosity which leads to the exploitation of the land.... We are stripping the natural world of all its raw materials such as water, minerals, and plants vital to the Earth's survival. The overuse of these materials will doom us, not to mention the buildings, clothes, and machines that make the natural world "unnatural" and polluted.... Our society has the hippies and activists to save the world, but there are so many unnatural things being produced, like growing industries and the production of cars, that make the precious natural world a part of history, never to return.... The natural world without human interference is self-sufficient and self-sustaining. The mysterious natural world can sometimes be unpredictable which actually makes it interesting to think about. People must learn to live differently if they want to keep this place. It is a very spiritual world if man's technology would not interfere with it. (SAU.n1 Narrative)

In addition to extremist views, it is important to note that in fact several of the students do not associate environmental issues with science. Rather than from their science classes, Art, Allen, Paula and others may well have gained their environmental consciousness from family, media, and other non school institutions.

Amongst this group of students, gender did not seem to be a factor in environmental awareness. Both the boys and girls in the study expressed strong interests and concerns about the environment.

Ann: It bothers me that people are so greedy and use nature. They take things for granted and don't think about the effect that they are having on the world. Many things are now polluted and our rainforests are endangered due to lack of caring. If everybody

would learn to love nature they would take better care of it. Everybody can do little things that would help. I do them every day. If we all had caring attitudes nature would be restorable. (ATG.n6 Narrative)

Bruce: The natural world is exploited because of us, humans. The earth is in danger because humans are destroying the ozone layer, rain forests and precious land. An incredible things is that our resources are being exploited and used up, and we need these things to continue our life on this planet. Resources are the "key to survival" and we are destroying them. We can restore our natural world to its "natural state" by conserving. We must learn to re-use our garbage and shrink the size of landfills. An incredible thing to think about is that we all live here and we are destroying our biggest resource, The Natural World. The Natural World needs our protection. We must learn conservation techniques in order to protect our resources so to avoid the damaging effects of pollution. If we act now by not burning the rainforests and stop dumping hazardous wastes we can avoid doom and the endangerment of any more animals. (SAU.n4 Narrative)

One sees in these students a concern that nature be protected because of the human need to sustain vital resources. Other students have religious motivations for conservation.

Ann: I also think about caring about nature. Because it is God's creation we are obligated to take care of it. (ATG.n6 Narrative)

Patricia: The Natural World was created by God so we can serve him and care for it. We have taken advantage of it long enough. (SAU.n2 Narrative)

Sally: I think of the natural world as what God gave us to take care of. In the bible it says we are superior to animals and plants. so we are supposed to take care of them. Religion teaches the caring attitude people must have in order to conserve our natural resources. We have an obligation to take care of this world because God created it for a purpose. (SAU.n5 Narrative)

Assertion #7: ***Neither gender nor science grade success of ninth graders is typically correlated with the view that scientific knowledge can facilitate the use and conservation of natural resources.***

As noted above this group of ninth graders exhibited a high degree of environmental and conservation awareness. Assertion six focused on the former. In terms of conservation, a similar pattern emerges. Neither gender nor science grade success is typically correlated with the view that scientific knowledge can facilitate the use and conservation of natural resources. Howard is a below average student but one with keen interests in science. Samantha struggles to succeed at school and has only shown a modest interest in science.

Howard: Nature provides us with many resources. Energy, shelter, food and water all come from nature. Scientific studies will allow us to use more of nature to our advantage. (ATG.n3 Narrative).

> Samantha: There are many things in nature that we understand now and we will understand more as we go along. Science often leads to understanding interesting questions. It can be used to help in conservation. Scientists and environmental organizations are concerned about conservation and our resources. (ATG.n5, Narrative)

Jackie has a "B+" grade average and expressed thoughts similar to those of Howard and Samantha.

> Jackie: Knowledge of the natural world also gives us the information needed to restore our world, such as the use of electric cars. We get some of this knowledge by taking science classes and through the media, like the discovery channel. We can learn about how technology is providing us with better and more efficient modes of transportation, and developments of solar power. (SAU.n3, Narrative)

These thoughts are little different from those expressed by the high grade achievers. Ann and Patricia are consistent "A" students across subject areas.

> Ann: We can learn to understand many things about nature through personal experience, school and science. Science, itself, provides us with technology which, in turn increases our scientific knowledge. Technology helps provide us with many "wants" which, of course, increases our pleasure. It also uses resources. (ATG.n6 Narrative)

> Patricia: Science provides ways for us to use resources but also ultimately exploits those resources.... Science teaches us how to conserve our resources and how to possibly restore them. Religion teaches us the caring attitudes required to be productive members of the natural world.... The natural world also provides us with many resources such as: food, fuel, minerals, and plants that give us cures for disease. Our knowledge of the natural world throughout science allows us to use our natural resources and at the same time exploit them. This exploitation will eventually put an end to Earth life as we know it, if we don't start changing our way of living.

Ten of the 16 students expressed such views as these. In contrast, however, to these rather positive views of science and resources, two students identified science as a source of resource abuse. Earlier we introduced Art who is something of a mystical environmentalist. In his view, "scientists and scientific knowledge are also increasing our tendency to pollute, destroy and clutter up the earth and space. They are trying to destroy it and study it at the same time" (ATG.n4, Narrative). Similarly, Paula commented that she did not, "understand the human world and why people feel the need to study nature. Studying nature only causes trouble. It creates more technology and curiosity which leads to the exploitation of the land" (SAU.n1, Narrative).

The remaining four students spoke in positive terms about conservation and resource use, but did not in any way related to science. Bruce is a "B" student and Allen a "C" student both of whom were quoted under Assertion 6. They use information that has a scientific source, for example the destruction of the ozone layer. They speak of things that need to be done to

conserve and protect the environment and these are things that scientific knowledge can support and investigate. Their speech, however, makes no reference to science.

Research Implications

Earlier we noted that SLCSP research takes it as axiomatic that the more educators know about students as people the better educators will be able to teach people as students in their classrooms. In order to know students as people they must be allowed to speak for themselves. In this research we have tried to construct a situation where students could freely express their thoughts and ideas about the concept of nature. The previous pages are filled with those ideas as well as the lessons (i.e., our assertions) we as researchers have drawn from what the students had to say. All of this raises a number of additional questions for research.

1. Will these students' conceptualizations change with greater maturity regardless of school experiences? In other words, were the thoughts expressed in these interviews largely a function of the immaturity of ninth graders? If one were to interview these students as 12th graders, would one find grounds for the same set of assertions?

2. Seeing the variation among students who are in the same science courses begs the question, What are their teachers and textbook like? How might assertions based on science teacher interviews differ from the set in this study?

   Related to this,

3. In the science classroom, what interactions, if indeed any, can be better understood by explaining the interactions in terms of teacher/student conceptualizations of nature?

   Moreover, there are questions that arise given the demographics of the students and school that participated in this research.

4. Given the particular characteristics of this community, what would the student conceptualizations of nature be like in different communities, for example, in an urban community? Would the same set of assertions obtain?

5. In a different community would there be gender characteristics not evident in this study? Would religious factors be as important in a different community? Environmental attitudes?

   Finally,

6. Nature represents only one worldview category. What would an examination of the other categories reveal?

These various questions will serve to give direction to future research endeavors and will be needed to maximize the usefulness of this research genre with respect to instructional implications.

Instructional Implications

As it is, the current findings do suggest various science classroom considerations. To begin with, it is instructive to compare some general features of these students' ideas with how the literature describes most science classrooms and curricula.

Ninth Graders' Conceptualizations	Speculative Curriculum Perspective
Broad range of concepts used	Narrow range
Strong aesthetic views	Non aesthetic view
Weak scientific view	Strong scientific view
Strong religious or spiritual views	Philosophical naturalism
Non gender specific views	Stereotypical masculine views

First it must be noted, in all fairness, that though the speculative curriculum perspective likely obtains in many classrooms, our own preliminary work with secondary science teachers shows considerable variation. Nevertheless, the same preliminary work shows the teachers to be much different from the students. The question is then, Does this difference between teacher and student make a difference in attitude or learning at the ninth grade level? Our preliminary evidence suggests that it does. We know at this time, for example, that Ann and Art have conceptualizations of nature that are considerably at variance from their two science teachers. We also know from comments made by Art and Ann that there are things that bother them about their science classes. While it is much too early to specify, what troubles these two students appears to be linked with the type of conceptual differences they have with their teachers.

Another question arises even if at this point we assume that the difficulties mentioned above are real. Does this difference have a long term effect or is it something students are likely to outgrow? Again, we have only evidence that suggests an answer. An earlier conceptualization of nature study was conducted with nursing students at the tertiary level (Cobern, 1993a) and currently we have under way a similar study preservice elementary teachers. In both cases the students interviewed are non science majors and in both cases assertions similar to the ones in this study obtain. The suggestion is then that differences noted at the ninth grade level are likely to persist.

Conclusion

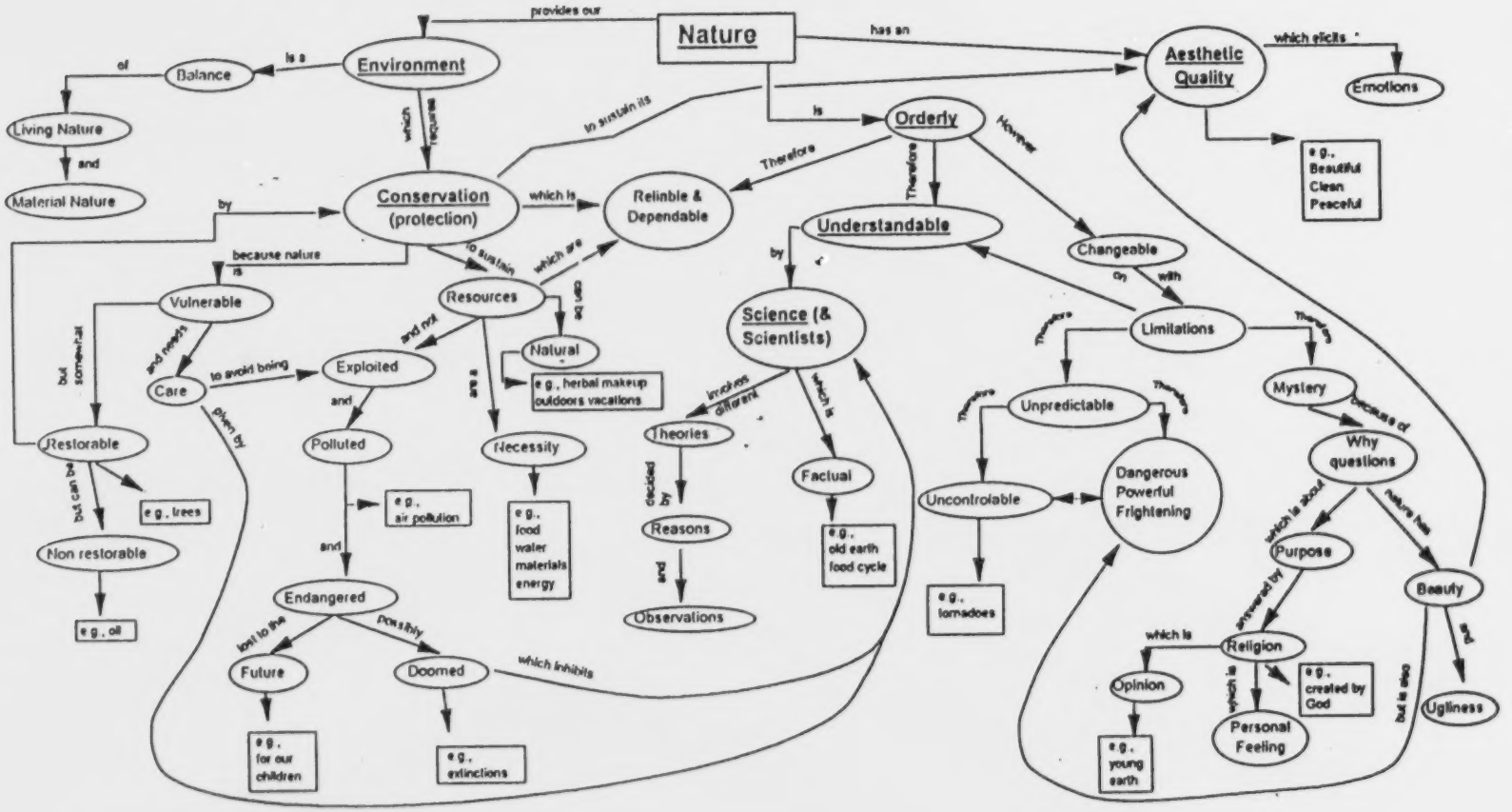
What are the concepts that have scope and force? Where are the science concepts used and to what extent? How are scientific ideas related to ideas from other disciplines? What is clear is that aesthetic, environmental, and religious ways of understanding nature are often stronger than scientific ways. Moreover, students understanding of science is also likely to be grounded in ways of knowing typically ignored in the science classroom.

Imagine the first day of a science class. A student walks up to the teacher and says, "Science is about the natural world, right? So before we start let me tell you what I believe about the natural world. After all, everything you say in this course, I will hear through the filter of my own viewpoint." In effect, this research is about giving voice to student world views. The research is predicated on the assumption that the learning environment of the science classroom

can be improved, especially with regard to students who typically do not do well or who do not like science, if the teacher is more aware of student world views as related to science. Developing awareness can be approached using a logico-structural theory of world view, specifically the universal categories NonSelf, Relationship, Classification, and Causality. At a minimum, this translates into questions concerning student views about nature, relationship to nature, and causality in nature. What is reported here is the first step in such a project. The research sought to give voice to student beliefs about the essence of the natural world. The objective of this study was to come to a better understanding of the cognitive culture of a particular group of high school science students. Results showed that student ideas are often both rich and rational, that students have reasons for what they believe. Yet within the richness of their comments, little was about science, and only one student's conceptualization of nature reasonably matched the naturalistic-mechanistic view of nature common to science education.

The research also raises new questions. To what extent can the belief space described in this research be attributed to the particular characteristics of the group? For example, would women accounting majors or male nursing majors view nature differently? To what extent is maturity and motivation a factor in the recontextualization of science? For example, do younger or less motivated students fail to take an interest in science because they do not, or cannot, recontextualize science? The stage is now set to address these questions and the associated issues of relationship to nature and causality in nature.

Maps and Narratives
(The narratives still require some editing)



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ATGN1

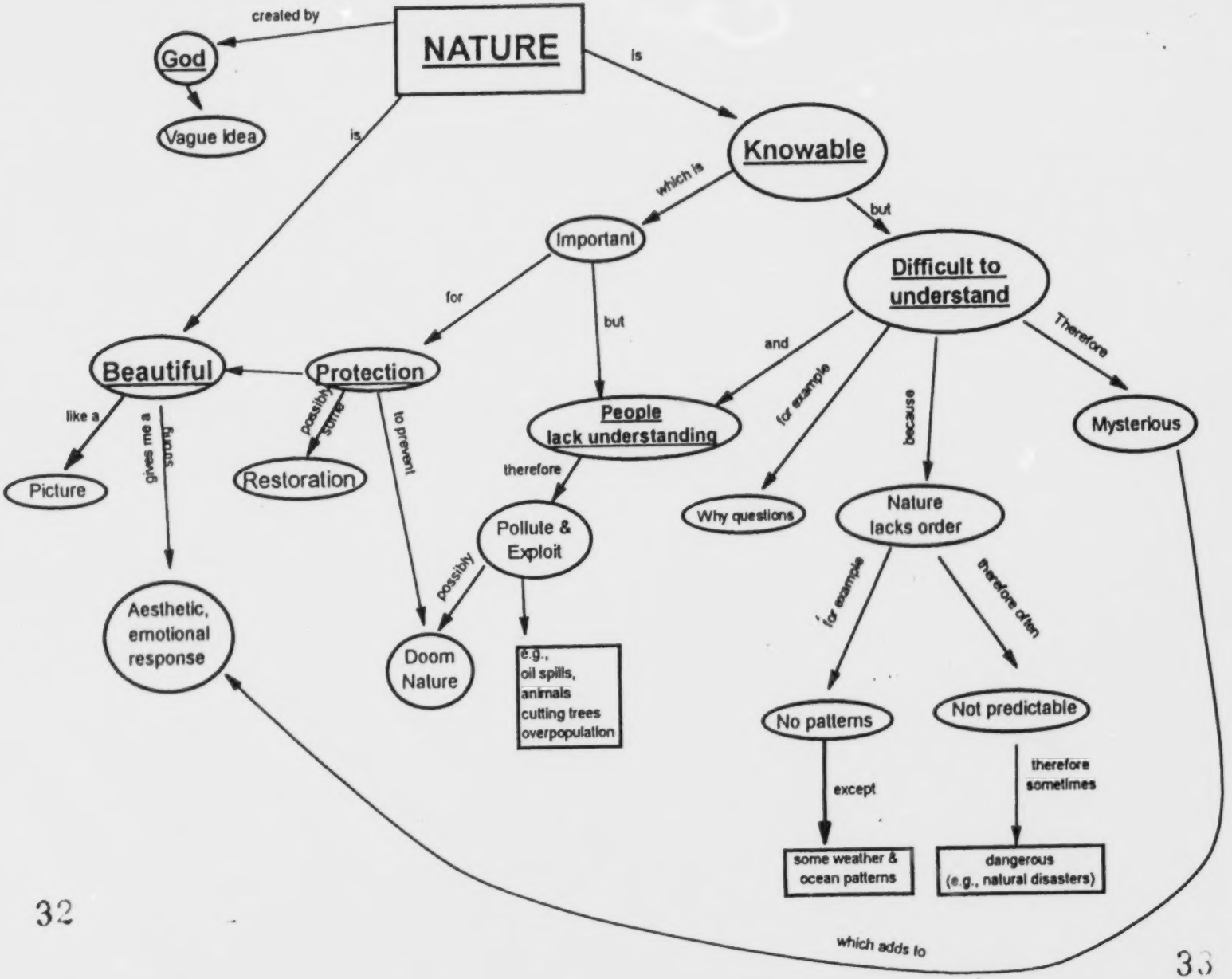
How could someone say 'nature is just there' is beyond me because its everywhere. Nature is everywhere. It can't be something that's just there. We can't go a day without using something from nature. We depend on nature for everything: material items, resources, ideas and pleasures. If we as humans aren't careful we are going to ruin the one thing that we need to survive.

I see many sides to nature. It is material...full of resources: It is living...it can be hurt. I think nature is very dangerous: I think nature is very beautiful. It can be beautiful and peaceful but also dangerous and frightening. A tornado, for example, can be beautiful and mysterious in its power and at the same time ugly in the damage it can do. Nature has a predictable, understandable side to it, but also, an unpredictable, uncontrollable side.

I want to be a scientist. Nature is very important to the world of science. Through science we understand many of the patterns in nature; food webs, weather patterns, how the solar system works, etc. We need to know more about nature and we keep studying it to find out how things work and to discover ways that different things affect each other. However, while science can work to increase our knowledge and understanding of nature, it is all people in the world that must act responsibly to help solve the problems we've created in nature. It will be hard for scientists to study nature in the future if we just keep destroying it.

We use a lot of material that nature gives. Nature is full of resources ...rocks, chemicals....gas, oil... trees, animals....and air and water." Exploitation is a problem . It is frustrating that many people, except scientists, don't care. Not all of the problems are correctable. Although nature is somewhat restorable, once plants and animals are extinct that's final. Is nature doomed? Yes, possibly! For lack of caring!

I'm not sure about the connection between God and nature. While I am a Christian I also believe that science has proved wrong, many of the things in the Bible. Yet I do think that there is a purpose for our existence and God is behind it. Science can explain how things work but there are many "why" questions that science doesn't answer. I have a very strong response to nature. I'm one of those people that is always thinking about nature in everything I do or want to do. While I see beauty in nature and that is very important to me I think it is far more important that we put out thoughts towards protecting nature at this time. My own personal enjoyment is secondary to that need. "Because nature is so important to us, it is sacred. We have to have it to live. That's kind of a big deal."

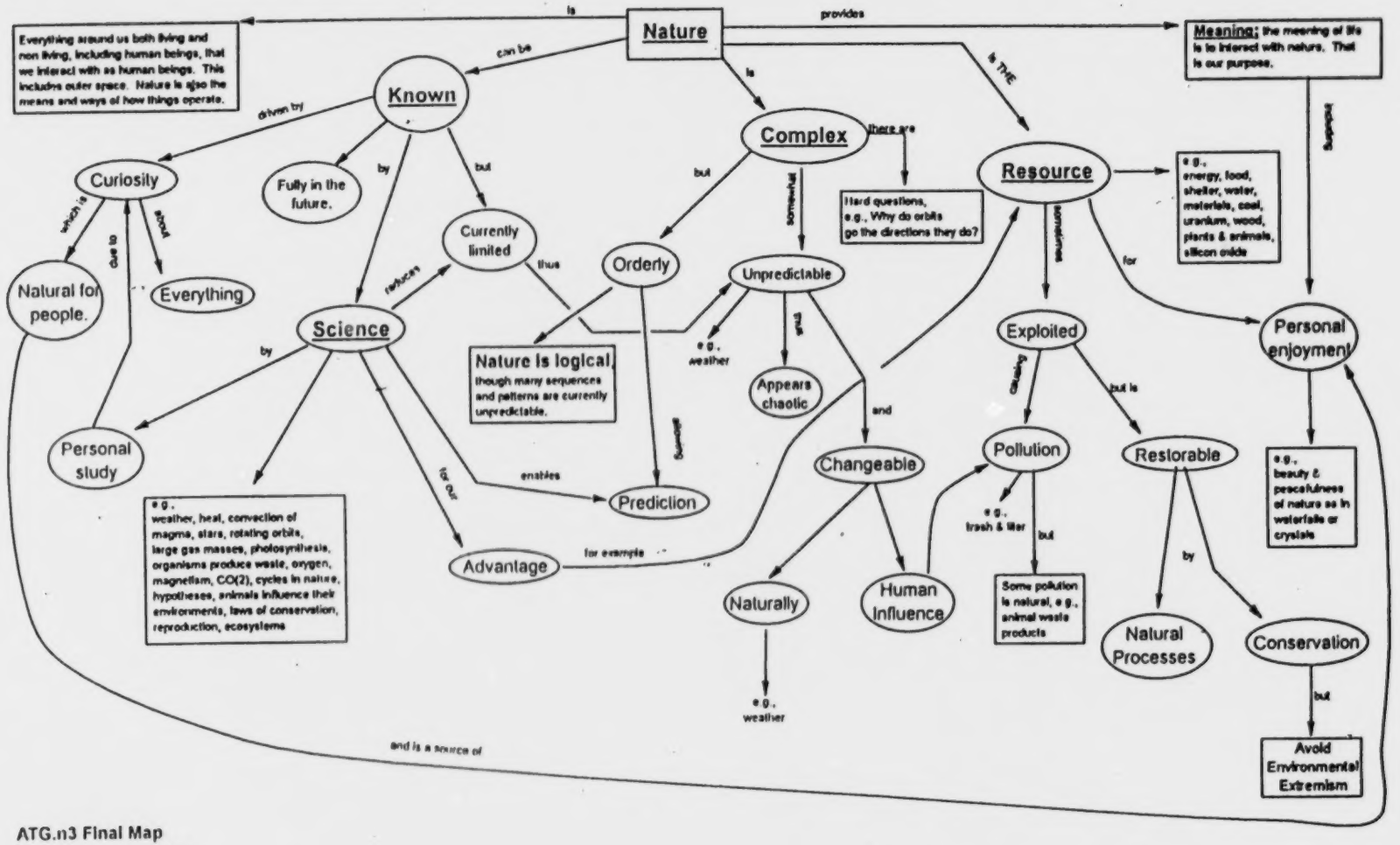

NATURE
created by
God
Vague Idea
is
is
Knowable
which is
but
Important
Difficult to understand
for
but
and
Therefore
Beautiful
Protection
People lack understanding
like a
Picture
gives me a strong
possibly some
Restoration
to prevent
therefore
Pollute & Exploit
possibly
Doom Nature
e.g., oil spills, animals cutting trees overpopulation
for example
Why questions
because
Nature lacks order
Mysterious
for example
therefore often
No patterns
Not predictable
except
therefore sometimes
some weather & ocean patterns
dangerous (e.g., natural disasters)
Aesthetic, emotional response
which adds to

ATGN2

Although I've thought a little bit about the natural world, I don't really understand a lot of things. I suspect that much of nature isn't meant to be understood. Because nature lacks order and is often unpredictable, it is often unexplainable. some things like weather and ocean patterns can be predicted but many dangerous things might not be predicted - earthquakes and natural disasters for example. Animals also do things that we don't understand and can't explain.

Some aspects of nature are knowable and it is important that we learn more about it. What we learn comes from both school and personal experience. Our lack of understanding of nature has caused us to exploit our natural resources. Ultimately we are causing permanent damage because of such things as overpopulation, oil spills, cutting down trees, pollution, etc. Possibly we are doomed. We might be able to do some restoration that might help solve some of our problems.

I really enjoy being out in nature. It gives me good feelings. I like walking around, climbing mountains, watching a deer drink out of a river and things like that. I think about nature and you could say I'm in touch with nature. Though I understand only a little about it, I like the mystery of not understanding everything. It adds to the beauty. Nature can be peaceful, with calm breezes, lots of nice trees and no trash. I also have some religious feelings about nature. Not necessarily those of any one particular religious group. I do think that some god created the earth. this confuses me also. I'm not entirely sure of my beliefs but I do think that a god created the earth.



ATG.n3 Final Map
29th November, 1994

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ATGN3

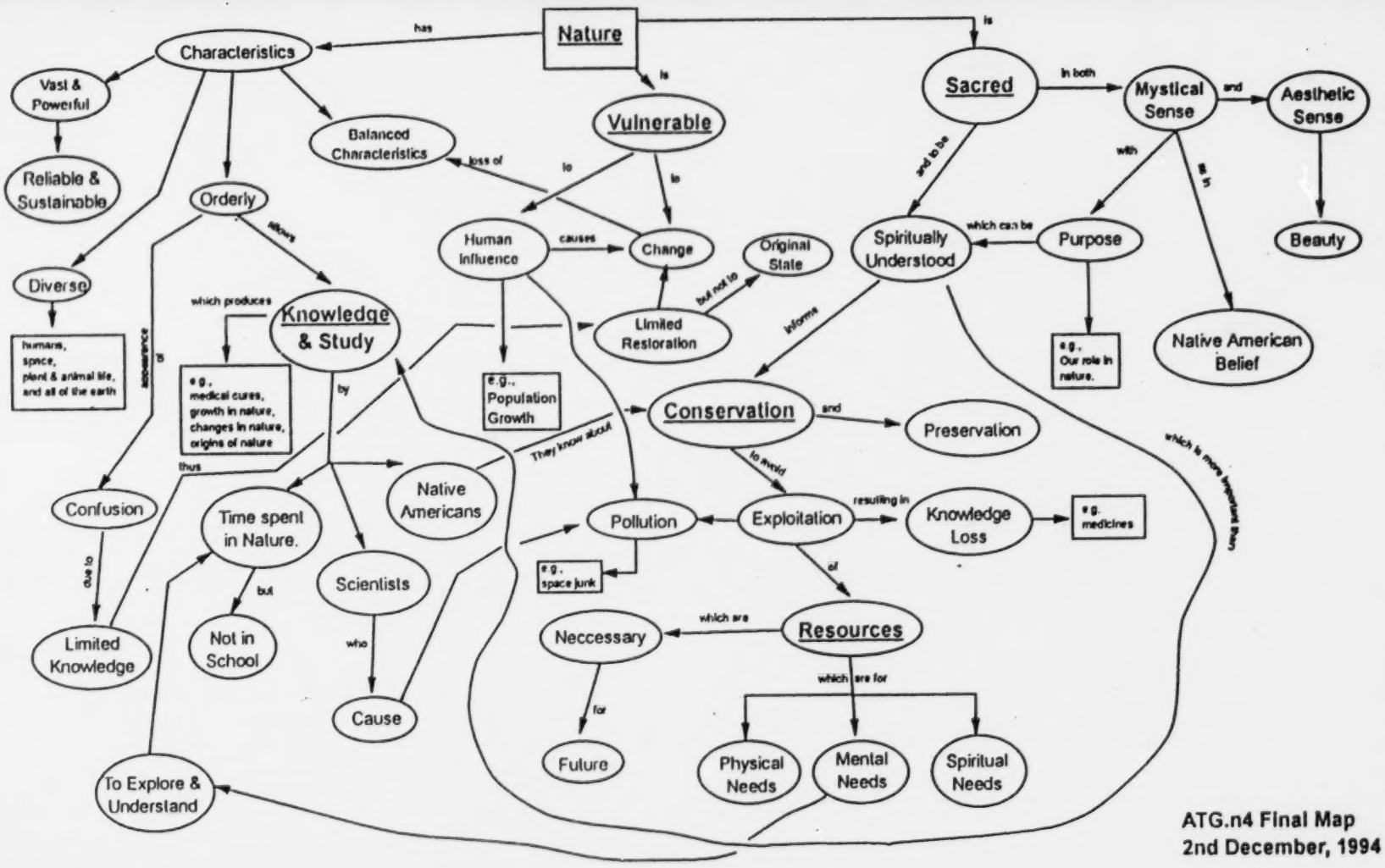
Nature is everything around us, both living and non-living, that we interact with. This includes outer space. Nature is also the ways and means of how things operate. The meaning of our lives is to interact with nature. That is our purpose.

I think that nature can be fully known because it is logical. we don't know or understand all of it yet but as time goes on we will understand more and more. Most things about nature are somewhat orderly or have a pattern to them. Because of this the study of science allows us to explain what is going on in nature. The orderliness lets us predict many things that are going to happen, like the weather, for example. Sometimes nature seems chaotic but that is mostly because our knowledge is incomplete and therefore our understanding is limited.

Because people are naturally curious they pursue studies of nature whether they are actively involved in Science or simply following up on a personal interest. I think that everything can be explained by Science. Matter, both living and non-living, and what it does follows basic laws. Things like the Law of Conservation of Mass, reproductive cycles of plants and animals, convection currents and ecosystems can be understood if the laws of science are studied. The study of science can lead to some hard questions, for example, "Why orbits go the direction that they do??" In the future things like this will be fully known.

Nature provides us with many resources. Energy, shelter, food and water all come from nature. Scientific studies will allow us to use more of nature to our advantage. Our exploitation has caused pollution. Humans have definitely influenced the natural world by building cities and communities but I think that nature is restorable. It can be restored by natural processes if left alone. We are also able to restore it somewhat by conservation efforts. We need to be careful, though, of environmental extremism.

Nature also has a beautiful side to it. It can be very peaceful. I find nature to be peaceful when I'm hiking up a mountain or something like that. But I also find it peaceful when I'm just walking around at night sometimes. I am a religious person but I also try to take things as they appear to me so I don't believe that everything in nature has a spiritual side to it. I do enjoy being out in nature and thinking about different aspects of it. There is a beauty in all the ideas that there are in nature to learn about.



ATG.n4 Final Map
2nd December, 1994

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ATGN4

"No matter what we humans do we're still natural and we're part of the natural world." I believe that man does not stand separate from nature but is part of it, including space, planets, oceans, living organisms and non-living things. Without the things we get from nature we could not enjoy the lifestyle that we have today. Nature is vulnerable to our influence and as our population has grown nature has been affected. Man has changed the natural world by exploiting its resources and polluting the environment. We have depleted the rain forests and changed the balance of natural things. I am concerned about the pollution we have caused, the things we have lost from the rain forest without knowing they are there, the damage we have done to Earth's water. Now we don't have the opportunity to gain knowledge from what we already have destroyed.

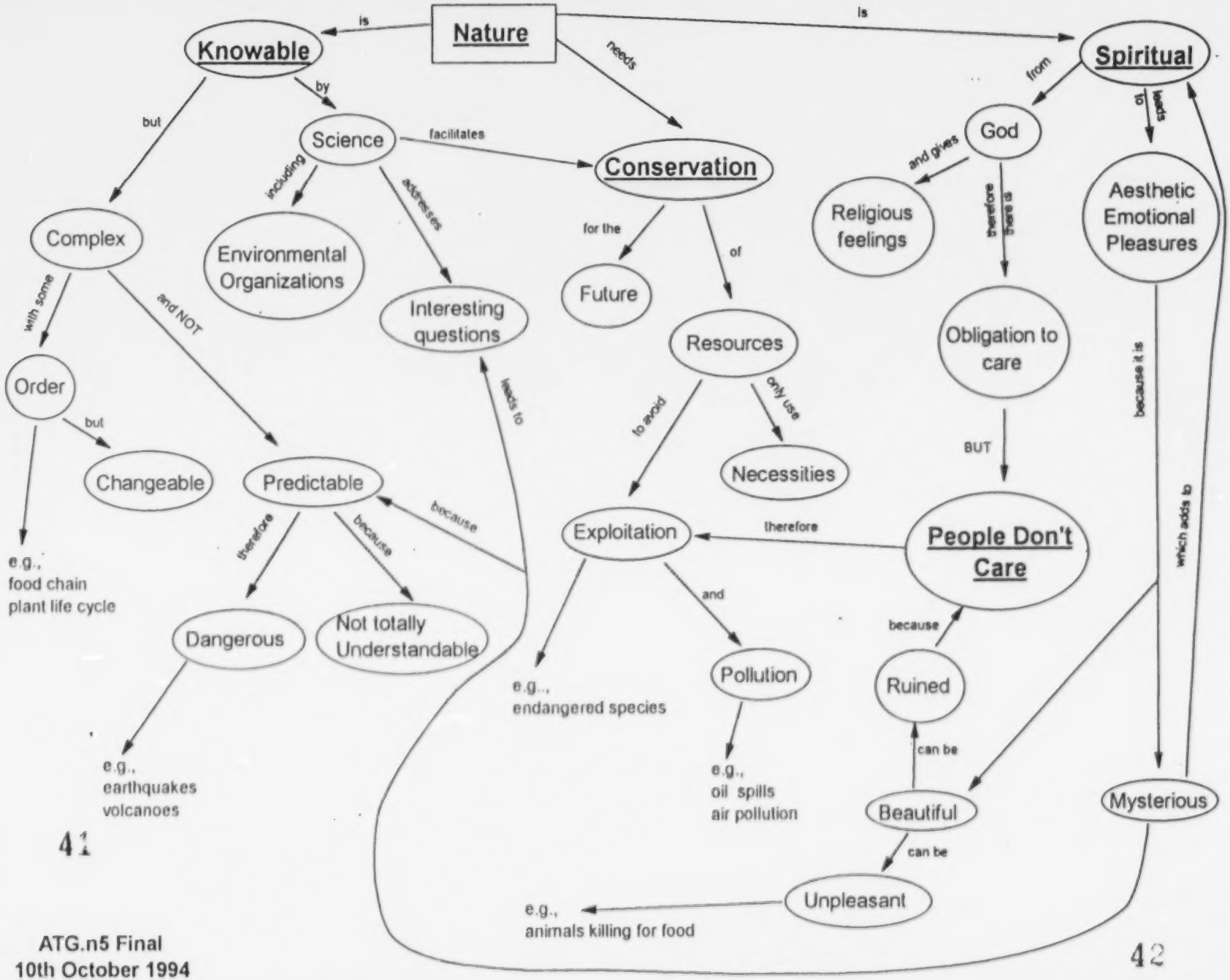
"Nature is a source of knowledge. That's a resource". Our ability to increase our knowledge and understanding of nature will allow us to correct some of the damage that we have done. Nature is not doomed. Although we will probably not be able to restore things to their original state man has the capability of making positive changes to the natural world as well as negative ones. Nature is not doomed. It can always take a different course and we are part of that course change.

At the present time our knowledge of the natural world is limited. Many things that we perceive to be complex and confusing because we don't understand them are actually quite simple and orderly. The construction of a spider web, for example, is quite a complicated operation to us but to the spider building the web it is a simple procedure. As we gain in understanding of the diversity and power of nature, we will understand the perfect balance of everything in nature. We will also begin to understand our place within nature. It is more important to have a spiritual understanding of nature than just scientific knowledge. That understanding can't be gained from school. You have to spend time in nature and learn to feel it. Than you will understand it.

There is a spiritual aspect to nature to many people. I find it quite beautiful, especially when I am looking out at a part of the natural world that is untouched by man. I appreciate the diversity of plants and animals in nature. Animals are very important to me, "I can feel things through animals". I enjoy watching them and learning about them. I understand why nature is sacred to some groups of people. It is sacred to me.

The American Indian culture has the kind of understanding for nature that encourages preservation rather than destruction. Scientists, also, are people that understand the need to preserve and protect. Some scientists and Indian cultures understand their role on Earth. They do not think of themselves as superior beings and don't feel that they have a right to go around destroying nature. They leave it the way it is because nature was made a certain way and it is supposed to be kept that way.
Unfortunately scientists and scientific knowledge are also increasing our tendency to pollute, destroy and clutter up the earth and space. They are trying to destroy it and study it at the same time.

I believe nature needs to be protected. Everything has a purpose that is put on this planet. We have a purpose here also. Maybe it is to preserve nature, have fun and enjoy the spiritual quality instead of destroying it.. It is our responsibility to know and understand human impact on the fragile, easily tampered with balance of the natural world. Nature is something felt! Understanding would be the most valuable key to the future of the world..


Nature
is
Knowable
by
Science
facilitates
Conservation
needs
is
Spiritual
from
God
and gives
Religious feelings
therefore there is
Aesthetic Emotional Pleasures
leads to
but
Complex
with some
Order
but
Changeable
and NOT
Predictable
e.g.,
food chain
plant life cycle
including
Environmental Organizations
addresses
Interesting questions
leads to
for the
Future
of
Resources
to avoid
only use
Necessities
Exploitation
therefore
People Don't Care
BUT
Obligation to care
because it is
which adds to
because
Dangerous
Not totally Understandable
e.g.,
earthquakes
volcanoes
e.g.,
endangered species
and
Pollution
e.g.,
oil spills
air pollution
because
Ruined
can be
Beautiful
Mysterious
can be
Unpleasant
e.g.,
animals killing for food

ATGN5

Even though nature is complex and hard to understand I think nature is inspirational. It has a powerful effect on me. Words like beautiful, powerful, pure and peaceful come to my mind when I think about nature. Nature is powerful, not only because of earthquakes and things but because of the effect it has on people. People relax in nature and enjoy themselves. That's powerful in my mind. My feelings about nature include religious feelings too. Sometimes when I think about nature, I also think about God. These are my first thoughts when you say the word nature.

Because nature comes from God, we have an obligation to take care of it. But nature has been exploited by many people that do not care about it. Many things have been ruined. Our earth is in trouble. It is being taken advantage of by people that are using parts of nature that don't really belong to them. This has caused a lot of pollution and wasting of endangered species. Most of the problems that nature has are caused by people not caring.

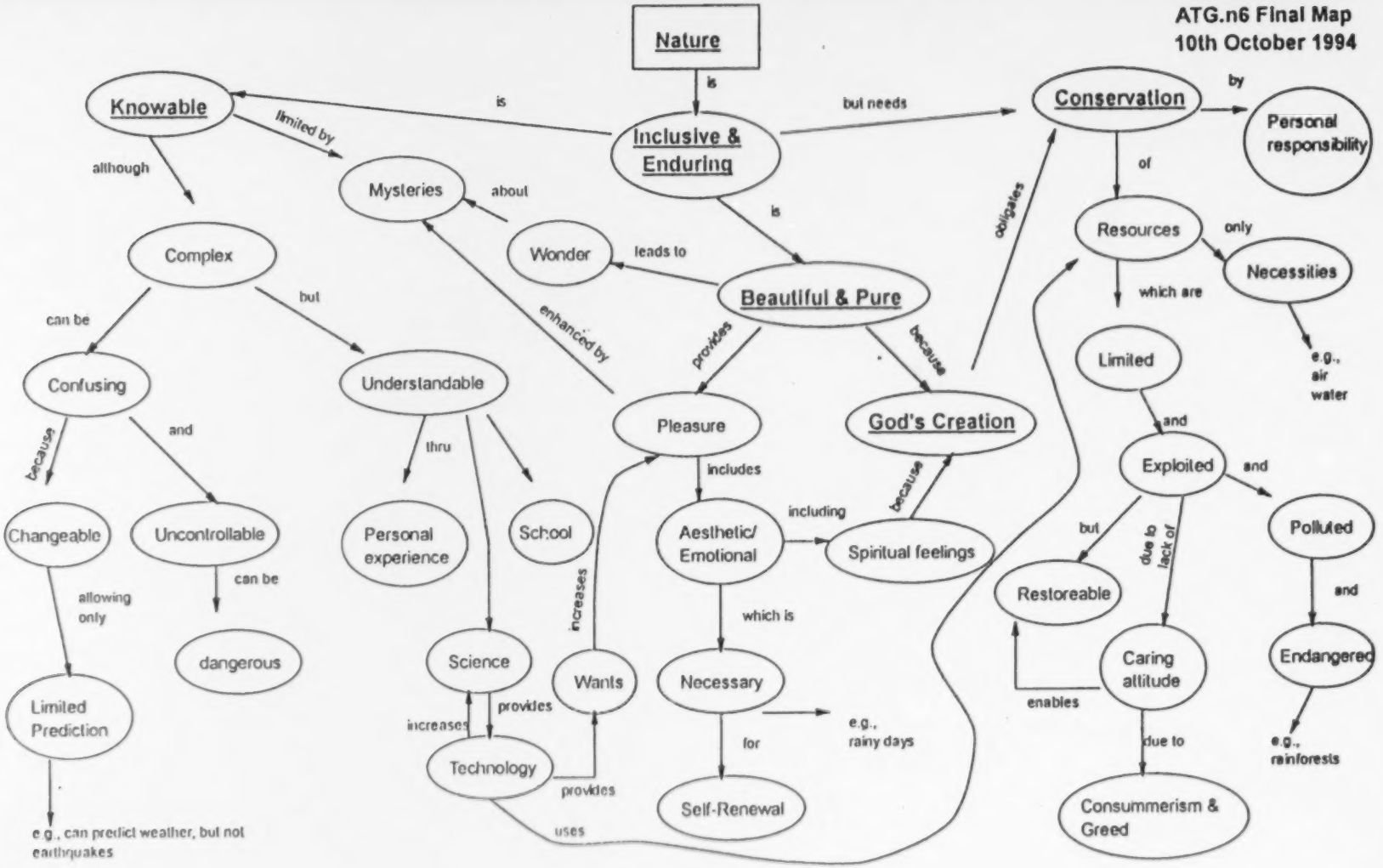
Nature needs our conservation efforts. we should be using only the resources that are necessities so that there is something left for the future. If we all worked together we could do some restoration but I don't think that that will happen. People just don't care.

Nature can be understood although it is very complex and sometimes difficult to understand. There is an order to part of nature. Things like food webs or plant life cycles can be understood and predicted. There are many things in nature that we understand now and we will understand more as we go along. Science often leads to understanding interesting questions. It can be used to help in conservation. Scientists and environmental organizations are concerned about conservation and our resources.

Other things about nature aren't so easy to understand. Earthquakes and volcanoes can't really be predicted and that makes them pretty dangerous. The danger there makes these things mysterious to me. That brings me back to my original feelings when I started to think about nature. It's mysterious, I like to think about it.

The pleasure I get from being in nature is very important to me. I spend a lot of time in nature. I'd be pretty bored if I didn't have it. It's sacred.

ATG.n6 Final Map
10th October 1994



ATGN6

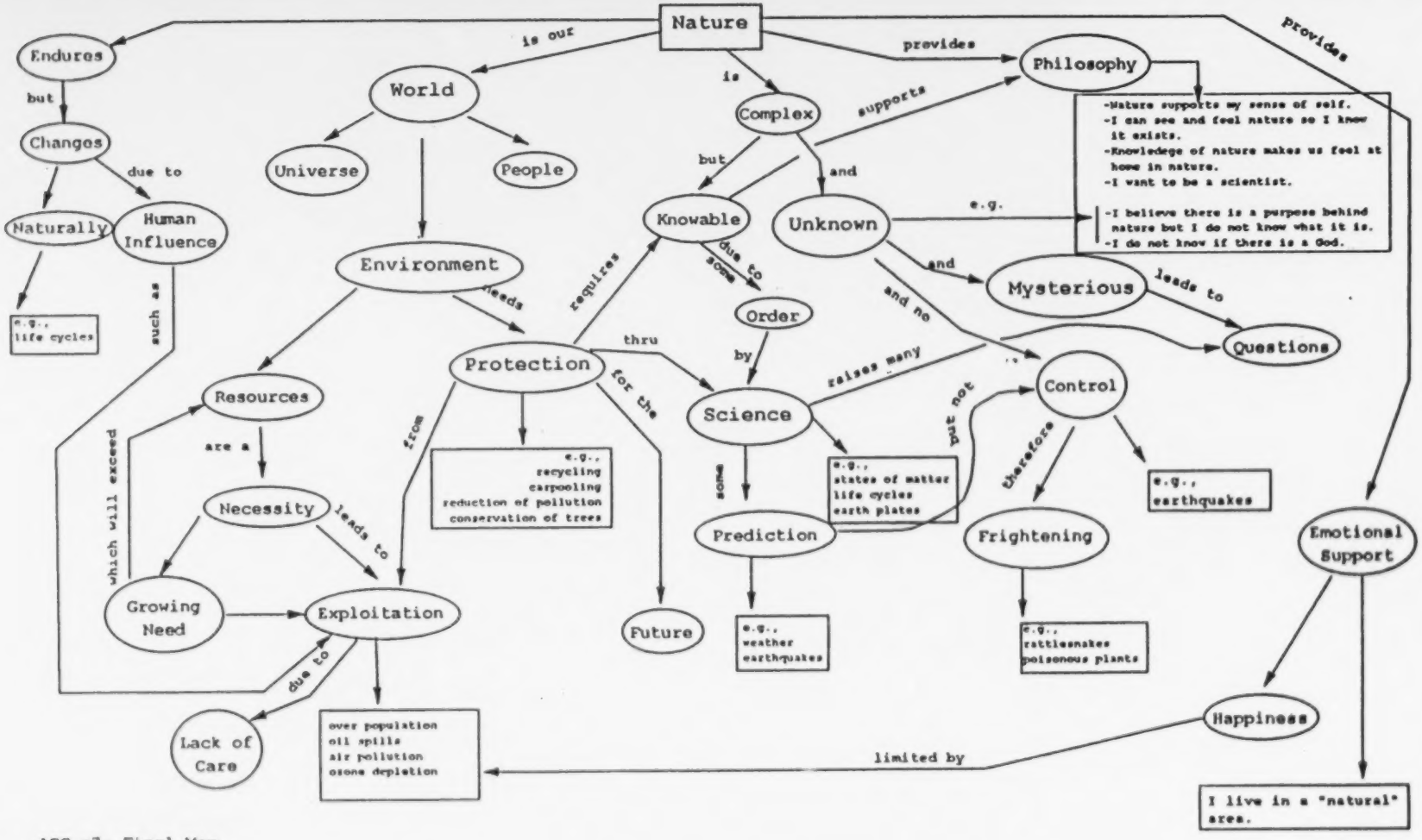
Nature is something that is always out there and it will always be out there. Everything that exists is a part of nature including you and me. To me, nature is beautiful and pure because it is God's creation.

Nature provides both aesthetic and emotional pleasure and I need it for self renewal. I like to go where you can't see any influence by man. When I'm out in nature I feel calm and peaceful. It is a spiritual feeling and it helps me understand myself. I also get a spiritual feeling from nature. Sometimes, when I'm out in nature and I have time to think, I start to wonder about things. This leads me to ask questions that I'd like to find answers to. The pleasure I get from nature is enhanced by the mysteries I see in it.

I also think about how caring about nature. Because it is God's creation we are obligated to take care of it. Natures resources are necessities but they are also limited. It bothers me that people are so greedy and use nature. They take things for granted and don't think about the effect that they are having on the world. Many things are now polluted and our rain forests are endangered due to lack of caring. If everybody would learn to love nature they would take better care of it. Everybody can do little things that would help. I do them every day. If we all had caring attitudes nature would be restorable.

Nature is knowable but the questions I ask about nature make me think that nature is sometimes very confusing. It is also changeable. There are some things like the weather that we can predict but other things are not predictable. some things, like earthquakes, can be dangerous because of their unpredictability. We can learn to understand many things about nature through personal experience, school and science. Science, itself, provides us with technology which, in turn increases our scientific knowledge. Technology helps provide us with many "wants" which, of course, increases our pleasure. It also uses resources.

I know that we can learn about nature and use that knowledge to change some things that we have done that are bad and to predict and/or control some of the problems that nature causes us. Nature has always provided for us. We can use our understanding of and caring about nature to correct some of the damage that we've done and protect nature for the future.



ATG.n7- Final Map
14th October, 1994

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ATGN7

"If we lose nature then we have lost ourselves, so it better be sacred to us or else we are in trouble" Nature is everything around us that was not made by man. Nature is central to our existence. It provides us with both beauty and resources.

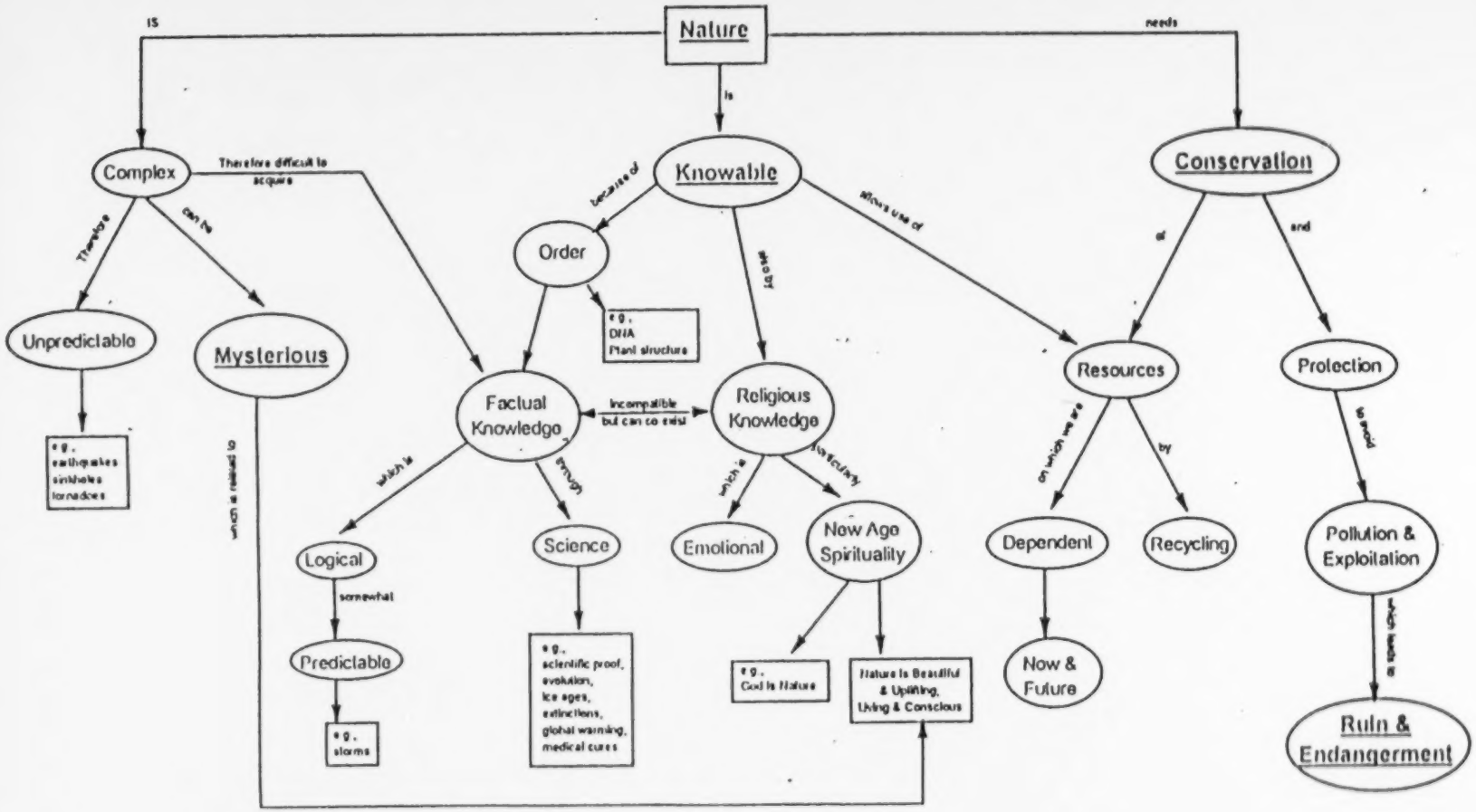
I live in a "natural" area. Being in nature is important to me. I can see and feel it so I know it exists. I enjoy the beauties of nature, the animals, mountains etc. It supports my sense of self. I believe there is a purpose behind nature but I don't know what it is. I'm not sure if there is a God or how God and nature are related.

I think nature is very complex. There are unknown parts of nature and they are confusing to me because there are no real laws controlling them. there is no order. These parts of nature can be very powerful, dangerous and unpredictable. Earthquakes are an example, also rattlesnakes. I think that because nature is so important to us we need to work to learn more about it. Knowing about nature makes us feel more at home in it.

There are also knowable parts of nature. We can learn about nature through science. There is order to some things and we can base predictions on that. Examples of knowable, predictable things would be states of matter, life cycles, the earth's plates and sometimes the weather.

Nature has always been here, but it has changed due to natural and human influences. The resources in our environment are a necessity to us for our survival. but our growing need has lead to exploitation due to people's lack of caring. Over population, oil spills, air pollution and ozone depletion are a result.

I want to be a scientist. Science raises many questions about nature. By trying to answer those questions maybe we can learn to restore some of the changed, damaged parts of nature. Our environment needs protection for the future. We need to protect the environment by recycling, car - pooling, reducing pollution, conserving trees, etc. The ability to protect requires knowledge.



ATG.n8 Final Map
6th December, 1994

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ATGN8

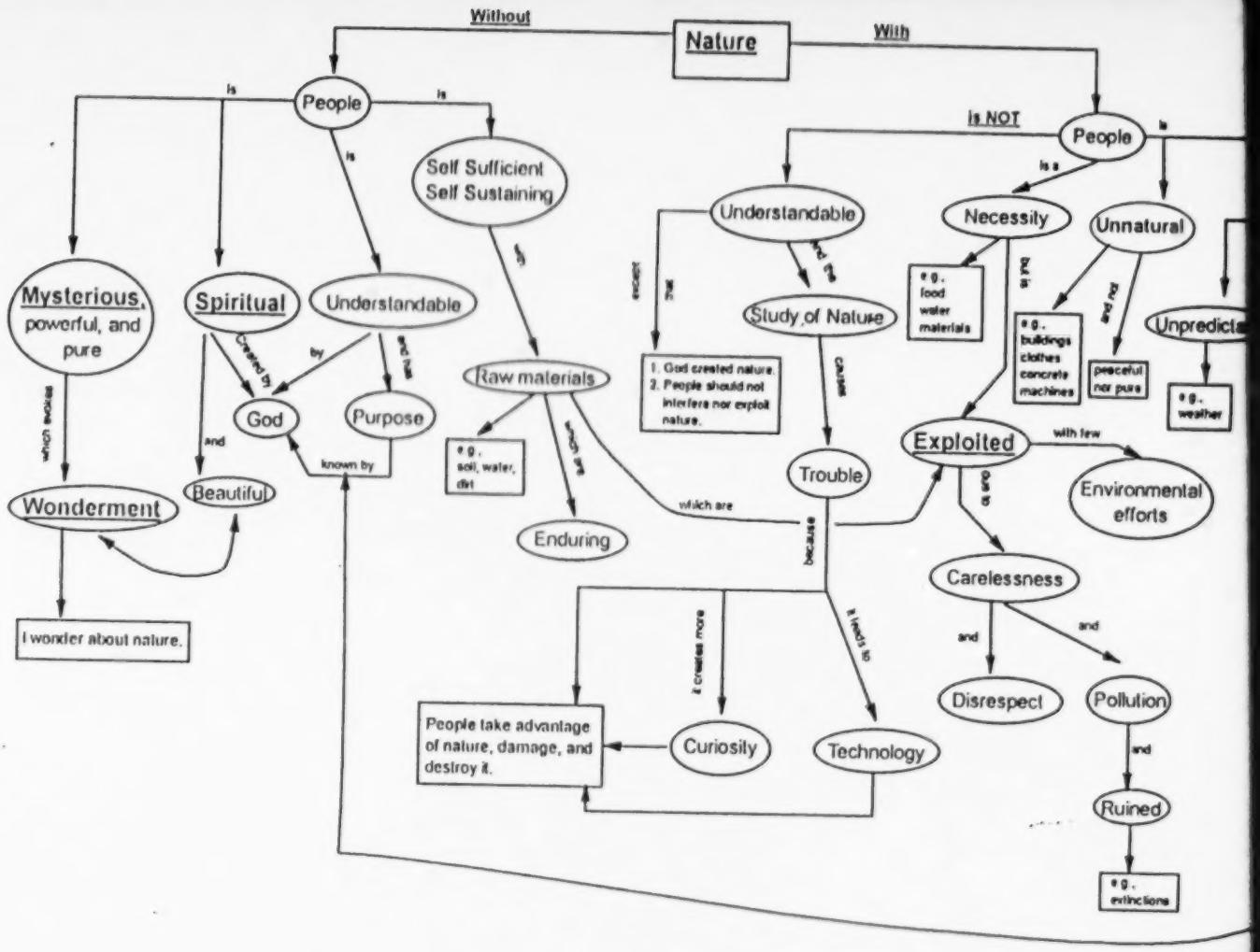
I think nature is basically everything. Man is part of nature. Even though we do some things that might seem unnatural, they are natural because we are natural. Nature is both knowable and mysterious. I think there are a lot of conflicts to be considered when you talk about nature.

Nature is knowable. But people know or understand nature in two very different ways. Some understand nature on a religious or spiritual level. They "know" nature as an emotionally uplifting experience. God and nature are intermingled in New Age Spirituality. Nature has aspects that can be considered not only to be living and but to also have consciousness.

Other people "know" nature on a scientific or factual basis. Their knowledge is based on facts and can be applied to solving problems as it is logical. There is an order to nature which we can use to predict some things, weather for example. Ideas about evolution, the ice age, extinction's and global warning can be developed and studied with scientific methods and proofs. Medical cures are another benefit we've gained through factual knowledge. We can also use our knowledge to make changes to nature. Some of the changes that we have made in the past and are making now aren't very beneficial to nature. We have exploited our resources and caused destruction. But our knowledge has also allowed us to do some restoration. My understanding of nature is more scientific and logical than spiritual but there are some aspects of both attitudes in my thinking.

Nature is complex and therefore mysterious. We don't understand a lot of things in nature because of its unpredictability. Tornadoes and earth-quakes are unpredictable and there are many questions that are still unanswered. Another reason that nature is mysterious is that it is living. Things in nature have a consciousness. That is something people don't realize or understand. The consciousness and the beauty of nature are powerful forces. They affect the way that people look at things and how they react.

Nature is not going to last forever. It needs protection and conservation. People should be more concerned about nature. They don't seem to care enough about the future and what will be left for their children. The damage that people do to nature worries me. Things like pollution and waste of resources are going to lead to more and more problems. People should realize that nature is a valuable resource. As such, it will be used up eventually. The more careful we are the longer it will last.



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SAUN1

Nature is mysterious. I wonder about nature. I would enjoy living in the mountains where the ground has been untouched by humans so I could appreciate the beauty and purity of the natural world.

I believe that there are two aspects of nature; the natural world and the human world. The natural world was only in existence before the dawning of man. God created the natural which makes it very mysterious and, for the most part, is unexplainable. God intended it to be here for a purpose which is only known by him. Because it is God's, humans have no right to mess with it. Even with the best technology and scientists we will probably not every fully understand nature. When man entered this planet, he destroyed its purity, beauty, and power. With the exception of "hippies", who value the spiritual ideals, the emotional values, and the mystery of nature, man has "doomed" the planet.

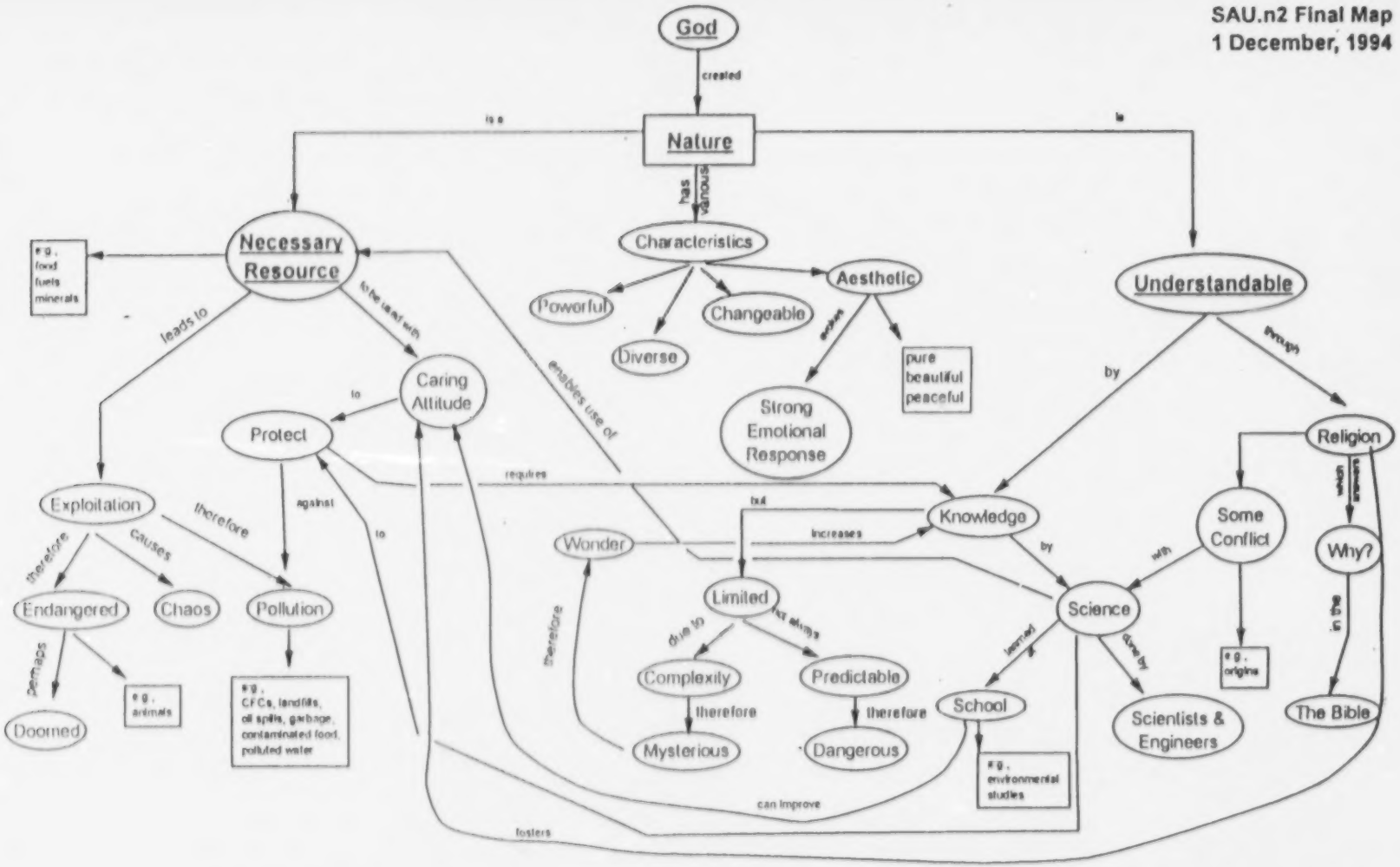
I don't understand the human world and why people feel the need to study nature. Studying nature only causes trouble. It creates more technology and curiosity which leads to the exploitation of the land.

We are stripping the natural world of all its raw materials such as water, minerals, and plants vital to the Earth's survival. The overuse of these materials will doom us, not to mention the buildings, clothes, and machines that make the natural world "unnatural" and polluted.

Our society has the hippies and "activists" to "save the world", but there are so many unnatural things being produced, like growing industries and the production of cars, that make the "precious" natural world a part of history, never to return.

The natural world without human interference is self-sufficient and self-sustaining. The mysterious natural world can sometimes be unpredictable which actually makes it interesting to think about. People must learn to live differently if they want to keep this place. It is a very spiritual world if man's technology would not interfere with it.

SAU.n2 Final Map
1 December, 1994



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SAUN2

God created the natural world. It has many characteristics: it's powerful, diverse, changeable, and beautiful (physically & emotionally).

Nature of the Natural World is anything made by God, all the plants and animals on earth and the entire solar system. The Natural World is very mysterious to me, I wonder about many things in nature. Something I wonder about is, "what is way out in the universe, perhaps another earth?" Even though nature is mysterious, everything is knowable but maybe not in the near future. The wonderment of the world increases knowledge through science but is limited due to it's complexity.

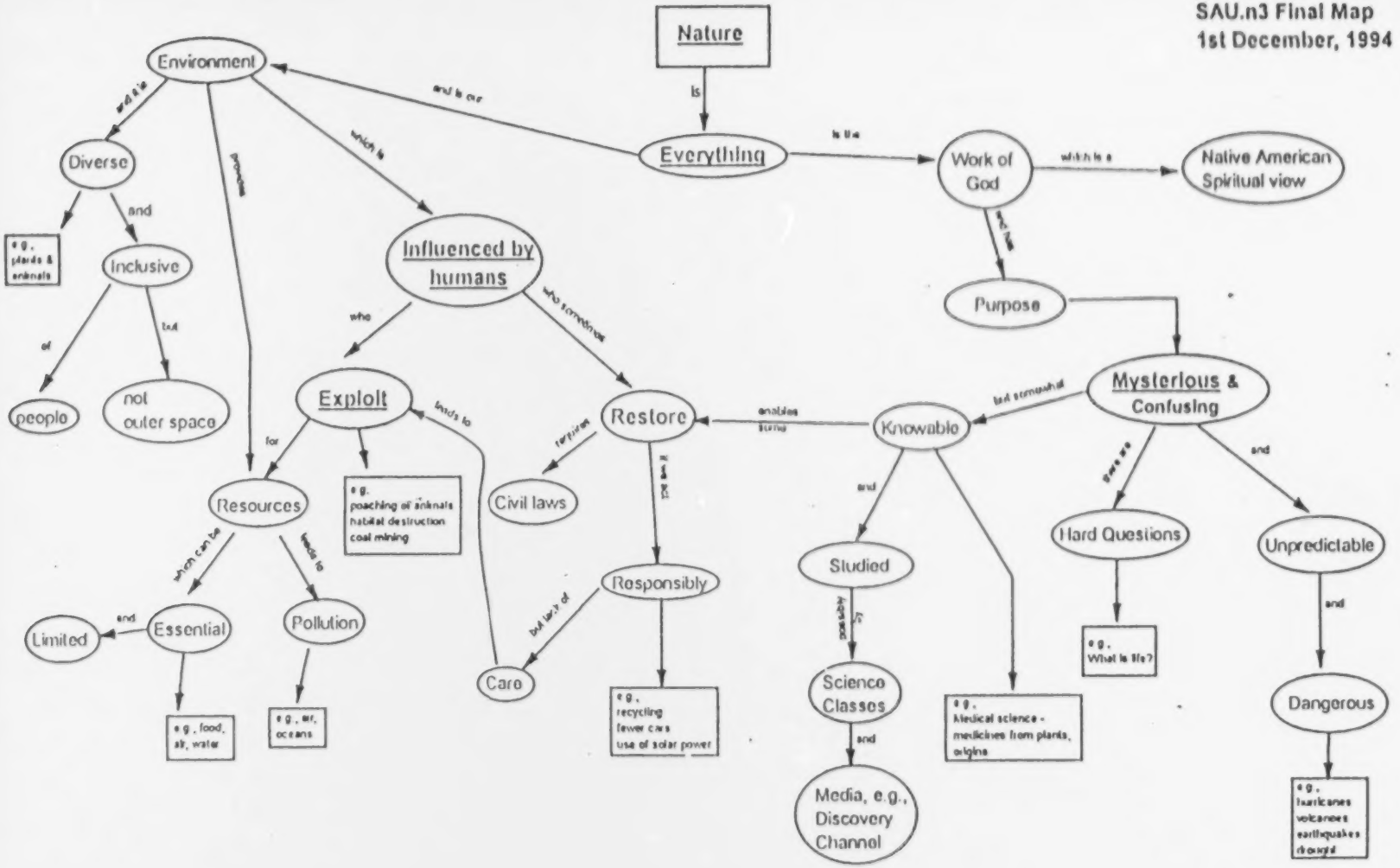
The Natural World has many different aspects adding to the complexity of it. It's always changing, "the same thing doesn't happen every day; an example would be the weather." Because of change it can also be beautiful in a naturalistic way. You don't have to know about things in nature to recognize that they are beautiful and sometimes pure.

Some aspects of the natural world are understandable. Science provides ways for us to use resources but also ultimately exploits those resources. In terms of religion the natural world is knowable because we have faith in the purpose of it, even though we don't necessarily know it. There is some conflict between the bible's teachings and views of scientists and environmentalists. Both worlds, science and religion, try to explain the hard questions such as the origin of life, in which I believe there is no true answer. Science and religion have distinct roles in our "life" teachings. Science teaches us how to conserve our resources and how to possibly restore them. Religion teaches us the caring attitudes required to be productive members of the natural world.

The Natural World also provides us with many resources such as: food, fuel, minerals, and plants that give us cures for disease. Our knowledge of the natural world throughout science allows us to use our natural resources and at the same time exploit them. This exploitation will eventually put an end to Earth life as we know it, if we don't start changing our way of living.

The Natural World was created by God so we can serve him and care for it. We have taken advantage of it long enough. People must learn to take the time to enjoy the beauty of nature both religiously and scientifically.

SAU.n3 Final Map
1st December, 1994



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SAUN3

Nature is alive. It is everything around us like plants and animals. It does not include far off planets because we don't need to deal with the problems there; we have our own problems.

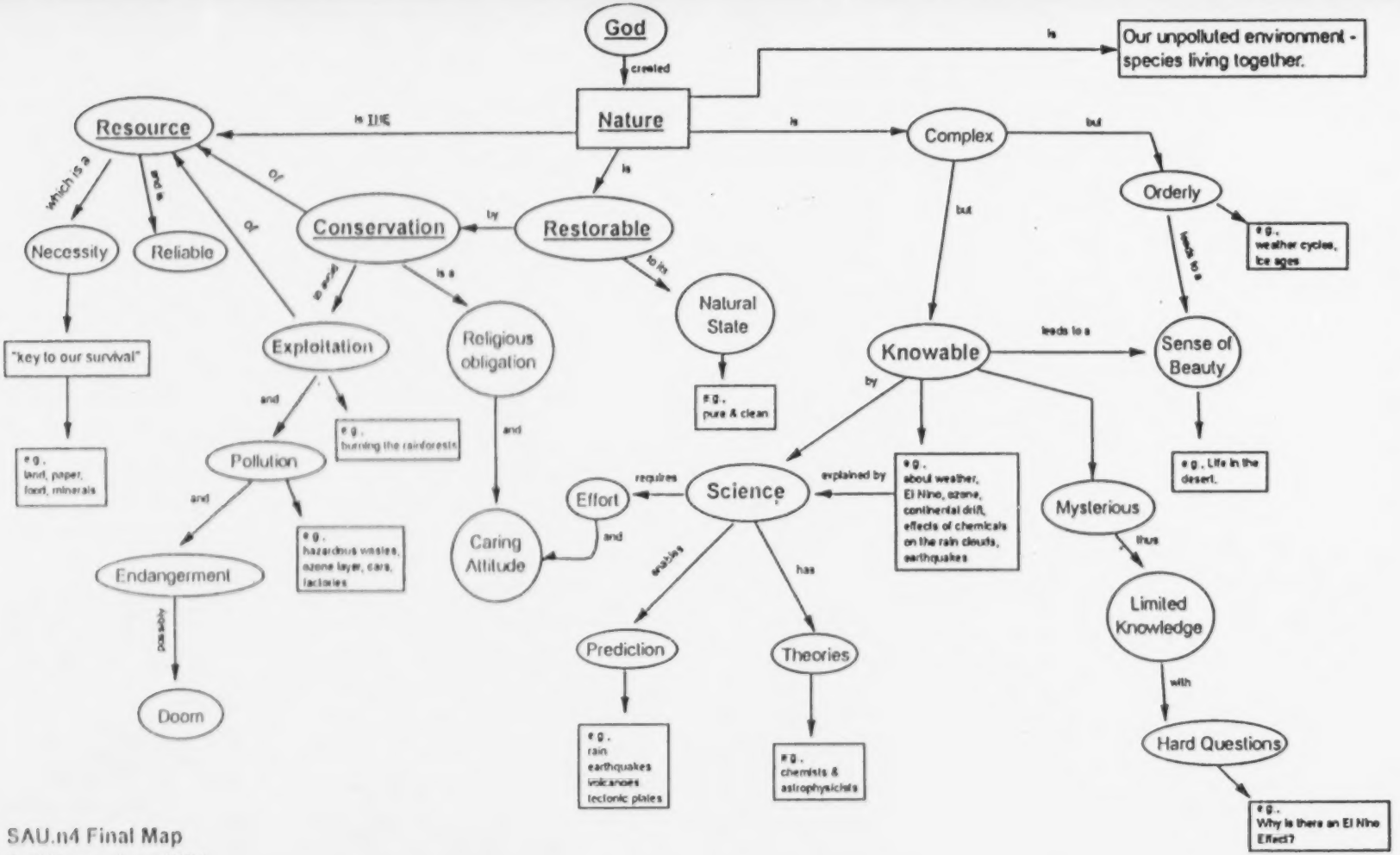
Everyone exploits the natural world. They poach endangered animals, destroy habitats, and strip the earth of our important resources. These resources are essential for life and exploited them not only leads to depletion, but using them leads to pollution that is destroying our ozone layer.

Some people restore nature, but because of lack of care and laws regulating technology, it is not being done properly. Everyone needs to recycle, carpool and even use alternate means of transportation for us to restore the natural world.

There are so many things to think about when dealing with nature. It is very mysterious; "how did the earth originate", "how does a baby form in the mother's womb", which makes it very confusing and unpredictable. The lack of predictableness, can be dangerous, such as hurricanes and earthquakes.

I don't mean to say that it is totally mysterious. There are some things that can be knowable, like medical science. We learn more every day through medicine like how to prolong life. Knowledge of the natural world also gives us the information needed to restore our world, such as the use of electric cars. We get some of this knowledge by taking science classes and through the media, like the discovery channel. We can learn about how technology is providing us with better and more efficient modes of transportation, and developments of solar power. The media is used primarily to warn us about the side effects of using products with CFC's and other damaging things that we are doing to the natural world. Our natural world is endangered and people must learn how to take care of it. The solution is recycle.

The natural World is everything that God created and therefore has a purpose. The Indian culture believes that this land is sacred and should be taken care of.



SAU.n4 Final Map
2nd December, 1994

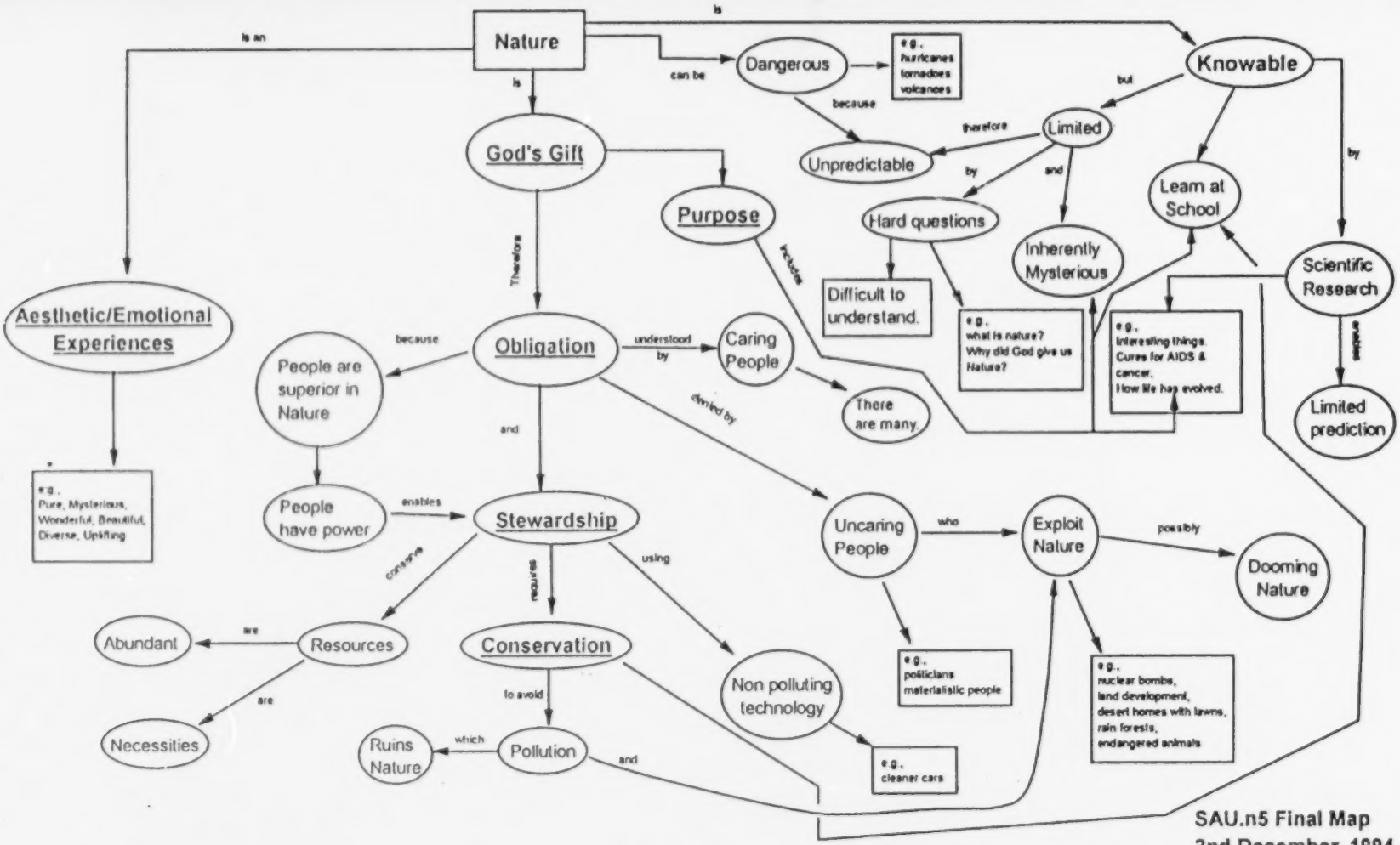
SAUN4

The natural world is a world that is pure, unpolluted; a place where everything can live together. Nature is complex, but it is orderly and knowable within a 20% or so margin of error. Most of the natural world can be known through science and the theories that have been developed by science. Science enables us to predict, to some extend, everything such as weather, volcanoes, earthquakes and earth movement.

Our knowledge is limited by hard questions, such as why does the earth spin the way it does, what is gravity, and why is our planet solid and not gassy. This mystery and the knowledge we have, leads us to a sort of philosophical sort of beauty. Having an open mind allows you to see the beautiful things in nature, like life in the Sahara Desert. Some people think it is ugly and a wasteland, but if you think about it, it has an abundant amount of life, which makes it beautiful. It is beautiful in different ways. There is the physical beauty and there is the emotional or "amazing" beauty. An example of "amazing" beauty is the way you think like when you look at the Sahara Desert, there is life in a seemingly dead place. That is incredible to think about. Questions about how the natural world works is explainable through science. Chemists and astro-physicists can come up with theories based on the order and the predictableness of the phenomena in the world. Some things scientists know about are: weather patterns, El Nino, Ozone depletion, and tectonic plate movements.

The natural world is exploited because of us, humans. The earth is in danger because humans are destroying the ozone layer, rain forests and precious land. An incredible things is that our resources are being exploited and used up, and we need these things to continue our life on this planet. Resources are the "key to survival" and we are destroying them. We can restore our natural world to its "natural state" by conserving. We must learn to re-use our garbage and shrink the size of landfills. An incredible thing to think about is that we all live here and we are destroying our biggest resource, The Natural World. The Natural World needs our protection. We must learn conservation techniques in order to protect our resources so to avoid the damaging effects of pollution. If we act now by not burning the rain forests and stop dumping hazardous wastes we can avoid doom and the endangerment of any more animals.

As humans, we have personal and religious obligations to our world to take care of it.



SAU.n5 Final Map
2nd December, 1994

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SAUN5

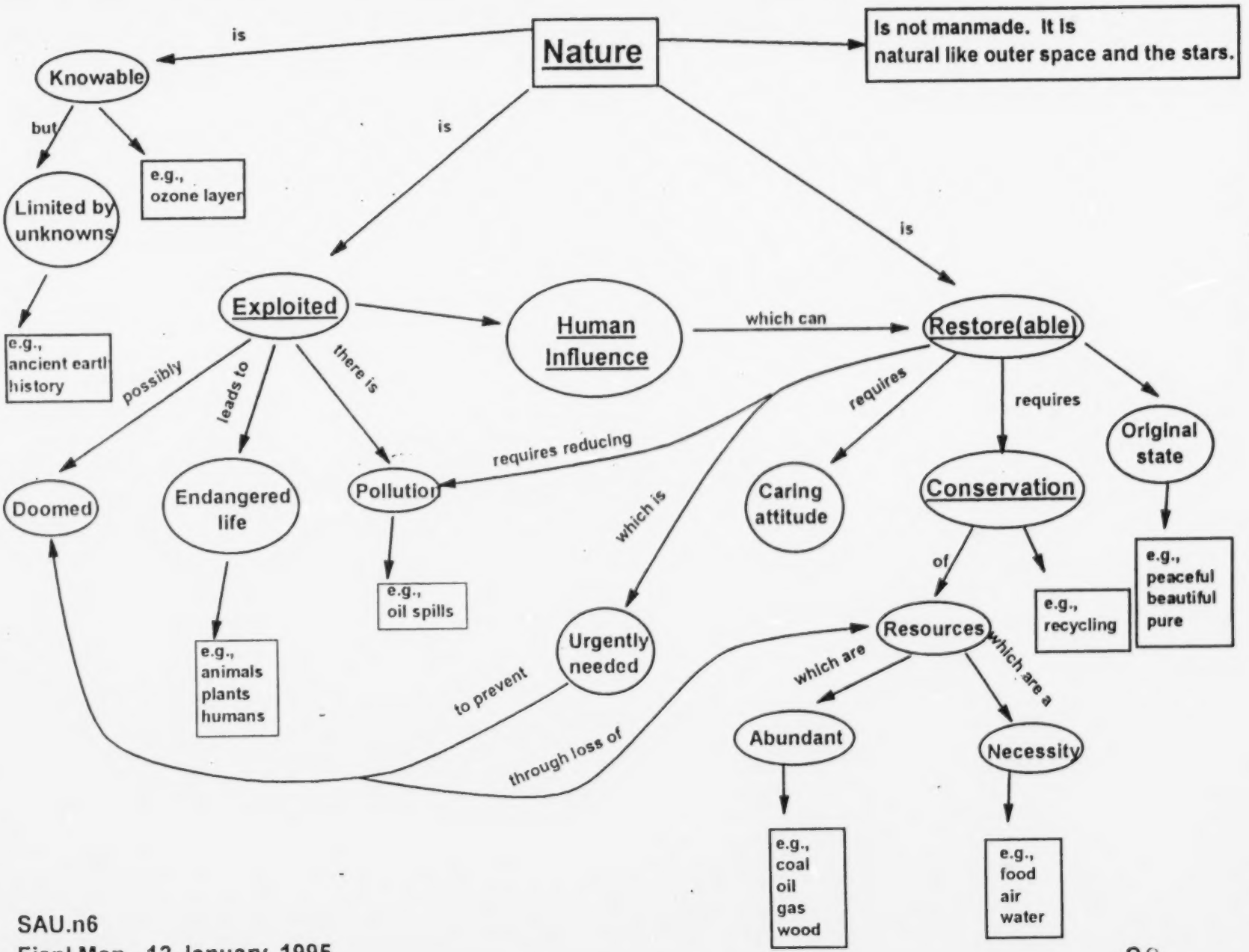
I think of the natural world as what God gave us to take care of. In the bible it says we are superior to animals and plants. so we are supposed to take care of them. Religion teaches the caring attitude people must have in order to conserve our natural resources. We have an obligation to take care of this world because God created it for a purpose. We don't know this purpose because it is beyond mortal thought.

Knowing that the natural world was given to us by God gives me a wonderful and uplifting feeling. God intended the humans to be the superior-powerful people they are, not so they could exploit nature but so they could become stewards of our Earth. It is a beautiful place, not only physically but emotionally.

The natural world is somewhat knowable through science and religion. It is to big to be entirely explained, for example, how can you be sure that an animal is truly extinct if you can't explore all areas of the world. Science and scientists help us to know some of the natural world because things can be predicted, like animal behavior. The predictableness allows us to answer how things work, but we will never really know why things work: Why is nature here, What is the purpose, or, How did life form? Some things are unpredictable like hurricanes, tornadoes, and volcanoes, which make nature dangerous at times. Science can teach us how to be better conservationists through research and technology so we can avoid pollution which ruins nature.

Sometimes people have too much power. Some of the uncaring with no religious background exploit nature by developing nuclear bombs, destroying land, ruining our rainforests, and endangering animals which will possibly doom us. Regardless of these people nature will survive because of the many people who do care.

People shouldn't have the power to destroy. They should only have the caring power. God would not have given all this beauty for us to ruin. We are stewards of God's land.



SAU.n6
Fianl Map - 12 January, 1995

69

SAUN6

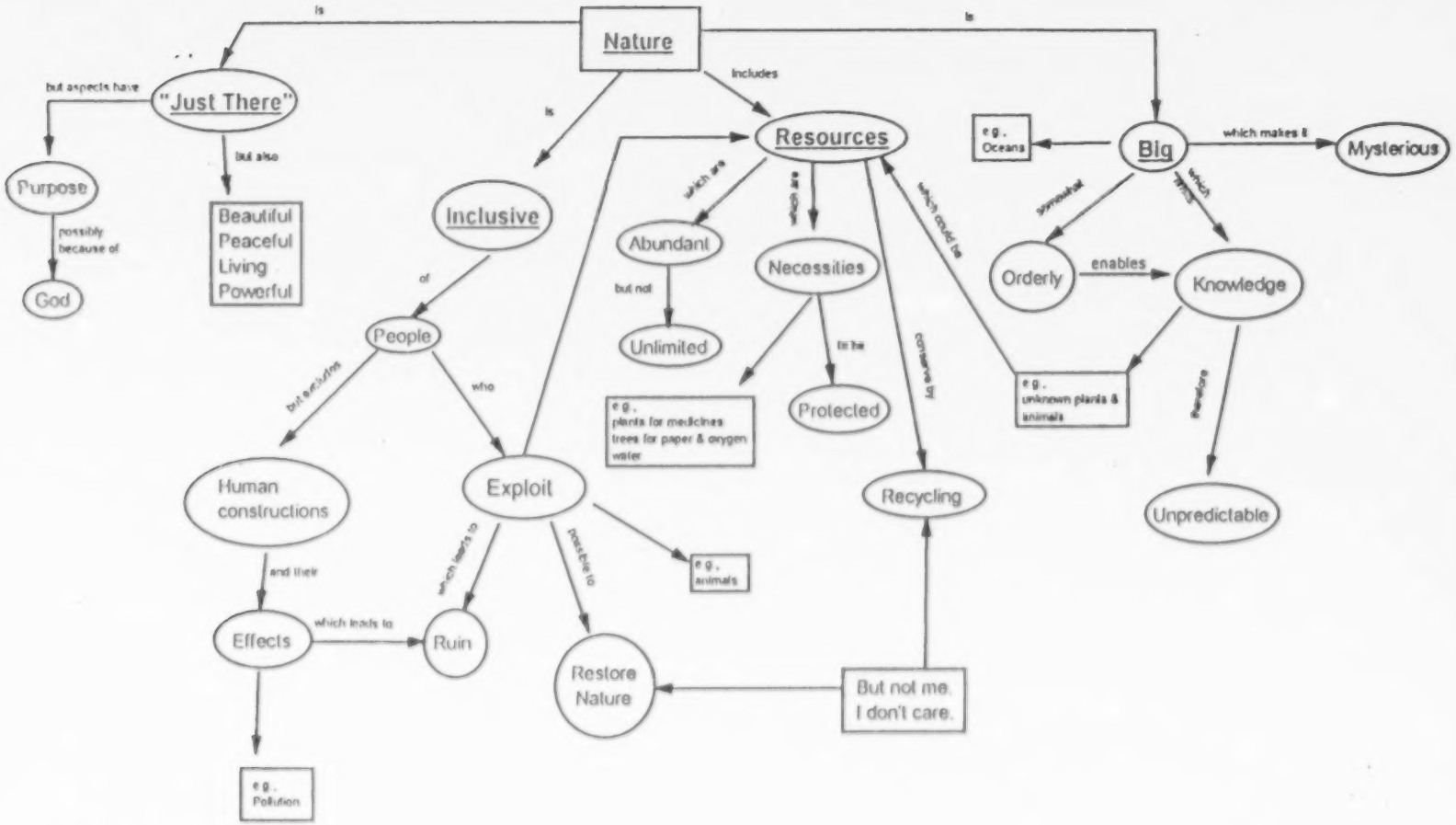
The natural world is not man-made, it is "plain living". It is everything that man does not interfere with, like outer space and the stars. Nature is knowable to some extent; like people can recycle and fix the ozone layer by not driving cars and stuff.

If all people would care about the natural world, we could restore it so it would not be doomed. People need to realize that they are killing animals, plants and eventually themselves by polluting our earth and not doing anything about it.

Nature gives us all we need to survive, like food, water and air along with the abundant resources such as coal, oil, gas and wood; so if we don't conserve these, the natural world would not exist as we know it. People know what they are doing when they burn the rain forests, pollute the oceans, and drive cars; why don't they care?

There are things we can do to fix the earth so it can be restored to it's original state which would be very peaceful.

SAU.n7 Final Map
2nd December, 1994



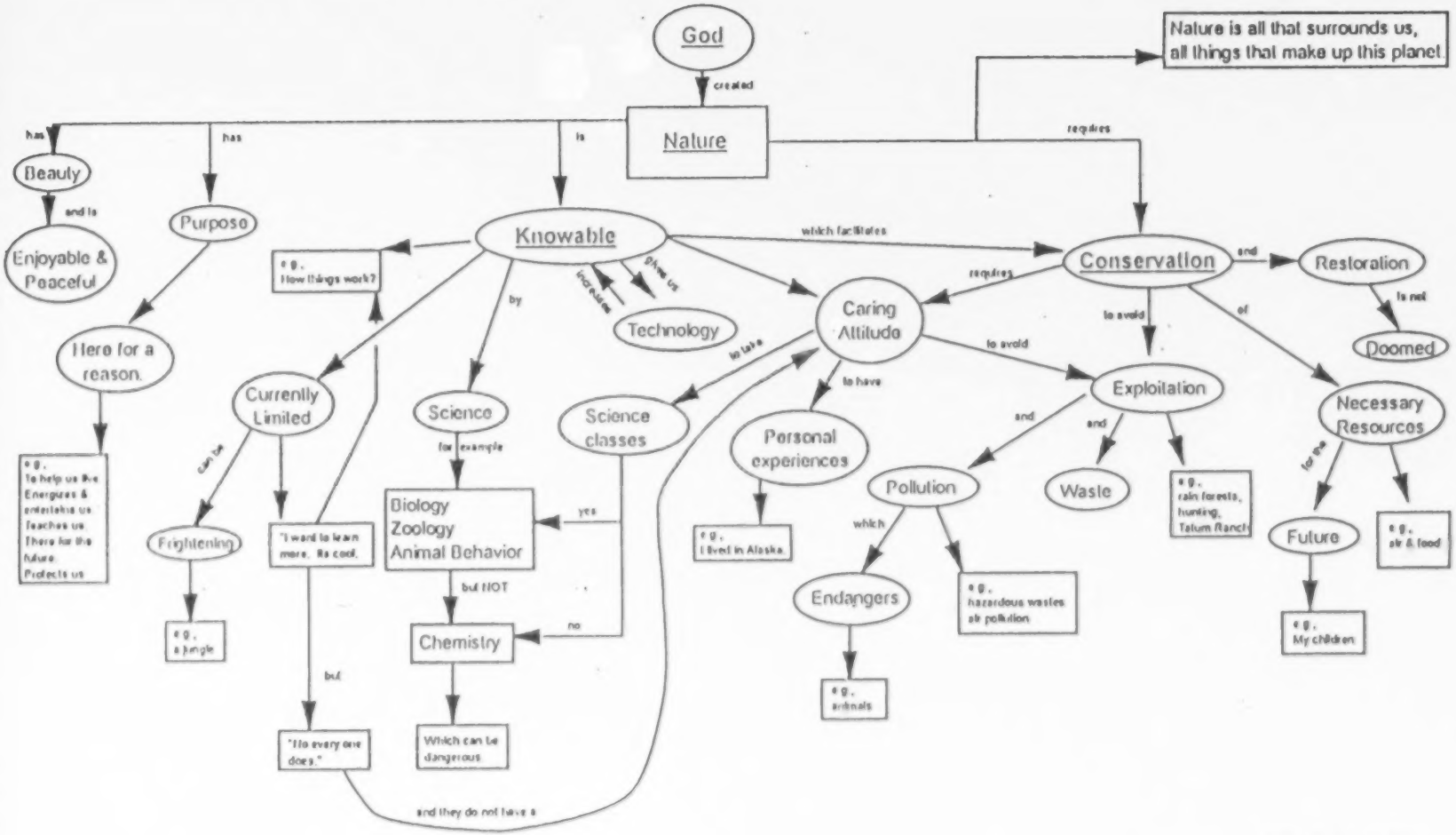
SAUN7

The natural world is just there, you know, fish, bugs, dirt, animals, and plants. There are aspects of nature that have purpose because it was probably created by God, but I am not really religious so I can't explain it. It is very big and complex, like the ocean, which makes it somewhat confusing to know about. There is some order in nature, but not much. An example would be like some parts of the land, like deserts, forests and oceans.

Humans are included in nature, but not the things they make, such as cities. Cities are not included in the natural world because they are built by unnatural means. Because of these cities, the natural world is exploited; like our resources that we use for medicines, paper and breathing.

People need to realize that our resources need to be protected because they are necessities for life. They can be recycled. I do not recycle because it is probably not in danger now or during my lifetime, so what's the point?

These resources are abundant but not unlimited. The natural world is being ruined and people need to begin restoring it. I myself really can't restore nature, but everything together can.



SAU.n8 Final Map
6th December, 1996

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SAUN8

The natural world is all the animals and the things around us. It also includes the environment and how they interact with it. The natural world also consists of ideas, why animals do certain things, their purpose, and what they think. It is the work of God. It's purpose is to help us live and enjoy the things (aesthetics) it provides us. Everything happens for a purpose.

The natural influences the way we think. Just thinking about the natural world gives us peace and energy by knowing that the animals are okay and to see that we are not the only organisms living here. I live out in the desert where I can enjoy looking and thinking about the animals that live there. I get peace from that. It also provides us with things to think about like, what's going to happen to us if we don't learn how to protect this earth.

The natural world is knowable by means of education through science and by learning through personal experiences. Eventually we will probably be able to know most things about the natural world. However some things will be kept a mystery because not all things are meant to be known. Science tends to teach the how and what questions about the natural world and religion hints at the why questions somewhat. Before it can be knowable to someone, that person must care about the natural world. Lack of care not only hinders your personal thought but sometimes leads to exploitation of natural resources and natural environments like the rain forests. Also, people like hunters take advantage of it by killing animals just for their skin and the fun of it. That is a waste of the natural world.

Because the natural world is knowable, it allows us to restore our natural resources by conserving them and uses of technology to possibly find new ones. However it is difficult to understand why people don't care enough to save our earth and not destroy things.

If we are going to use technology and the natural world to our advantage we must first learn to care so we can put an end to pollution which could eventually make us doomed. The natural world is here for a purpose, and that is to help us in our studies and for us to use it rationally. We must be careful because this is the only earth we have.

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